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R denotes Reviews of Books. **P N** denotes Patent Notes. **T N** denotes Trade Notes and Novelties and Mechanical Department.

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THE DUPLEX DYNAMOS AND MOTORS.

ELECTRIC lighting in its struggle for victory over oil and gas has not only been dependent upon improvements in lamps but upon the evolution of the dynamo; and each new stage in the larger utilization of electricity for light and power has been marked by the production and popularity of forms of machines that were not asked for during the earlier periods of development. A feature of this later work, moreover, has been the attention it has commanded at the hands of engineers and concerns who have entered the field of dynamo building just as they might have entered that of engine building—not with the object of keeping within the strict and narrow limits of a "system" but solely, as manufacturers and engineers, to construct the best apparatus that the needs and knowledge of the hour would permit. This is an altogether healthy and encouraging sign, since it places dynamo building in line with the other mechanical industries of greater age, in which the success of apparatus has come to depend upon merit, rather than upon accidental and adventitious conditions.

Among those who have steadily forged ahead in the creation of a standard series of dynamo machines is the Duplex Electric Co., Ltd., of Corry, Pa., who are now building machines adapted for both generators and motors ranging in capacity from 50 to 135 h. p.

Recognizing the desirability of avoiding the use of countershafting as much as possible, the new type of machines are constructed on the multipolar plan, the general outline of the magnetic field being shown in the engraving Fig. 1. The machine complete is shown in perspective in Fig. 2. The armature is of the Gramme ring type, and as an example of the methods adopted in the construction of these machines we give below the figures relating to the No. 10 dynamo:

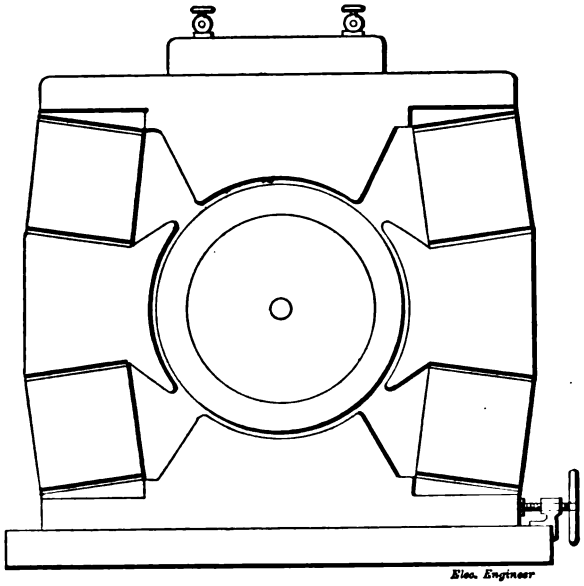


FIG. 1.—MAGNET FRAME OF DUPLEX DYNAMO.

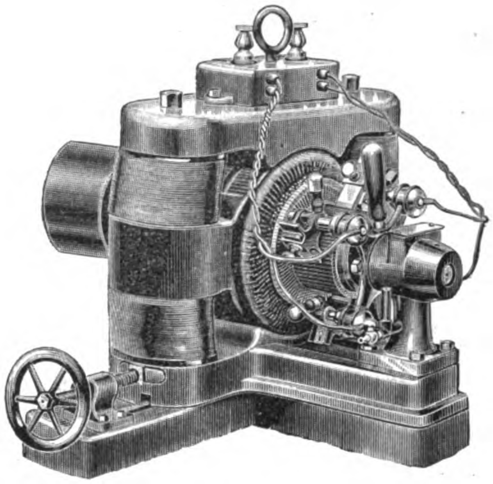


FIG. 2.—THE DUPLEX DYNAMO MACHINE.

Incandescent lamp capacity	500
Current capacity	275 amp.
E. M. F.	110 volts
Electric power	27,500 watts
Power required for driving	40 h. p.
Resistance in shunt field	23.7 ohms
" " series "	0.0066 "
" " armature	0.0078 "
Speed	750 r. p. m.
Weight	3,500 lbs.

The machine, as will be noted, is compound wound and hence regulates automatically throughout its entire load, no rheostat being required.

With the construction adopted involving so high a ratio in the field and so low a resistance in the armature and series winding, an electrical efficiency of over 95 per cent. is attained with a commercial efficiency of over 92 per cent.

THE DIAMETER OF FULGURITES.

WHEN a bolt of lightning strikes a bed of sand, says an exchange, it plunges downward into the sand for a distance, less or greater, transforming simultaneously into glass the silica in the material through which it passes. Thus, by its great heat, it forms at once a glass tube of precisely its own size. Now and then such a tube is found and dug up. Fulgurites have been followed into the sand by excavations for nearly thirty feet. They vary in interior diameter from the size of a quill to three inches or more, according to the bore of the flash. But fulgurites are not alone produced in sand; they are found also in solid rocks, though very naturally of slight depth and frequently existing merely as a thin glassy coating on the surface. Such fulgurites occur in astonishing abundance on the summit of Little Ararat, in Armenia. The rock is soft, and so porous that blocks a foot long can be obtained, perforated in all directions by little tubes filled with bottle-green glass formed from the fused rock.

WHAT AN ELECTRICAL DICTIONARY MIGHT BE.

BY

Edwin J. Houston

UNDER the above title Mr. Park Benjamin has described in the issue of THE ELECTRICAL ENGINEER, of June 22, 1892, the lines along which, according to his judgment, an electrical dictionary should be written. Although he says the article referred to was not written as a review of the second edition of my "Dictionary of Electrical Words, Terms and Phrases," yet, as I have prepared such book along the exact lines he thinks should be avoided, it may interest the public generally if I explain why I believe such lines to be eminently those along which a practical book should be written; for, what I have at least aimed at, although I may have fallen short of the mark, has been to prepare a live book, for use at the present time, and not one "whose practical value will be inversely proportional to its age."

While I quite agree with Mr. Benjamin in some respects as to the possible advantages which may be derived from a dictionary such as he believes the electrical dictionary of the future should be, yet I submit that such a dictionary would not reach the principal class for which dictionaries of all kinds are prepared; namely, the great reading public; as well as the great army of workers in the many electric and co-ordinate industries.

Mr. Benjamin has described a dictionary which would unquestionably be of great use to that limited class, the scientific expert, of undoubted value to that equally limited class, the philologist, and of unquestionable value to that rapidly increasing class, the expert electrician; but, to the great majority of busy workers, and of general readers, it would prove, what I fear some of the large dictionaries of to-day prove to the busy inquirer of knowledge, viz., one perpetual conundrum as to what such words mean to-day. For my own part, when I wish to know the exact meaning of a word as used during a certain age, I go directly to dictionaries of that age. But this cannot be done as regards electrical terms, for there were no electrical dictionaries in the early history of the science, and the glossaries of terms were exceedingly limited, and, as a rule, quite unsatisfactory.

Mr. Benjamin has pictured to himself the electrical dictionary of the future as any other distinguished expert, such as he is, would delight in. This book is to contain all the evidence required in great patent suits ready at hand, and accurately recorded, so as to avoid those researches into electrical literature, that are at the same time so laborious to the expert and expensive to his client. Such a book would, undoubtedly, be of great value, but it would hardly be a dictionary in the modern sense of the term.

As regards Mr. Benjamin's statement that, "The general public can find all the electrical terms it needs set forth, with sufficient fullness, in existing text-books, and in the great dictionaries, such as the 'Century,'" I would respectfully suggest that the general public are not so fortunate as Mr. Benjamin, who is in possession of one of the most complete electrical libraries in the country, and, even if they were, there are comparatively few who have either the time to consult such works, or the necessary knowledge to find the information desired.

As regards the latter part of the statement as to the sufficiency of the existing great dictionaries to correctly interpret electrical literature as found to-day in the leading technical journals, I feel sure that although such dictionaries are fairly complete, any one would be convinced of the contrary, if he made an actual trial. A technical dictionary is necessary correctly to interpret technical literature; especially, technical popular literature.

Mr. Benjamin assumes that the modern dictionary of electricity should be written for the electrical expert. So it undoubtedly should; but by no means for the electrical expert alone. Its principal province is to meet the wants of the vast army of electrical artisans, mechanics, linemen, station men, trimmers, engineers, firemen, motormen, electroplaters, electrotypers, electro-chemists, telegraphic and telephonic operators, and numerous others, and especially for that still greater class, the general business public, to whom an exact knowledge of the meaning of electrical words, terms, and phrases is a necessity of their business life, and to whom, with all deference to the great dictionaries already existing, such dictionaries are insufficient, as indeed owing to the technical character of the words contained, they must be.

In view of the various classes for which the modern as well as the future electrical dictionary is to be written, there should, in my opinion, of absolute necessity, be inserted cuts of all articles, even including "a Wheatstone bridge or a typical resistance coil." A definition of a Wheatstone bridge might be given that would be sufficiently exact to give some idea of the thing itself, but would necessarily be too labored and extended for practical use. Insert a good cut describing the thing as it actually appears, and, after all, it is only another kind of language, —and how much clearer the definition becomes!

It is the province of a dictionary to define words, terms and phrases correctly, and any means which will throw light on each definition and so prevent ambiguity must necessarily make such a work better as a dictionary. Indeed it appears to me that the dictionary of the future must necessarily be encyclopædic in character in order to avoid some of the other objections which Mr. Benjamin thinks he sees in the dictionary of to-day.

As regards encyclopædias, so far as my own experience goes,—after wading through an immense mass of uninteresting, unnecessary and irrelevant details, in which I am not interested, in order to get at the precise meaning of a certain thing, I either find such information carefully concealed, or exasperatingly vague,—I am decidedly of the opinion that the encyclopædias of to-day would be greatly improved if in all cases they were expected to give in concise language just what certain things are, or do mean, and then to add such explanatory or descriptive matter as seems to be required.

The vast increase in the sum of human knowledge would, it seems to me, render it more and more necessary for the future electrical dictionary to be constructed along lines exactly opposite to those described by Mr. Benjamin.

Of course there can be but one criterion for a correct definition, and this is to be found in the "general consensus of opinion." For this, the opinion of no single person or authority can, or should be, accepted; but, after all, the consensus of opinion must be formulated by some one, and the modern as well as the future dictionary must contain such formulated opinions, unless the dictionary is to become a complete library in itself.

It would seem to me that the words, terms and phrases embodied in the modern as well as the future electrical dictionary should be defined practically along the following lines, namely:

(1.) Such definitions should start with a concise definition of the word, term or phrase, giving the meaning generally accepted during the present time. These definitions, though given by a single mind, will by no means be of necessity only what the framer of such definition understands the words, terms or phrases to mean, but the significance which he believes that all who employ such words, terms or phrases, give to them.

(2.) There should then follow such full descriptive matter of the scientific principles or of the apparatus involved in the definition as the space of the work will permit. If such a method intrench on the province of the encyclopædia it will by no means impair its value as a dictionary but on the contrary will greatly enlarge the sphere of its usefulness.

(3.) Cuts of the things described should by all means be annexed. I believe all lexicographers are agreed in this respect. Mr. Benjamin will find the latest dictionaries filled with cuts describing the things defined.

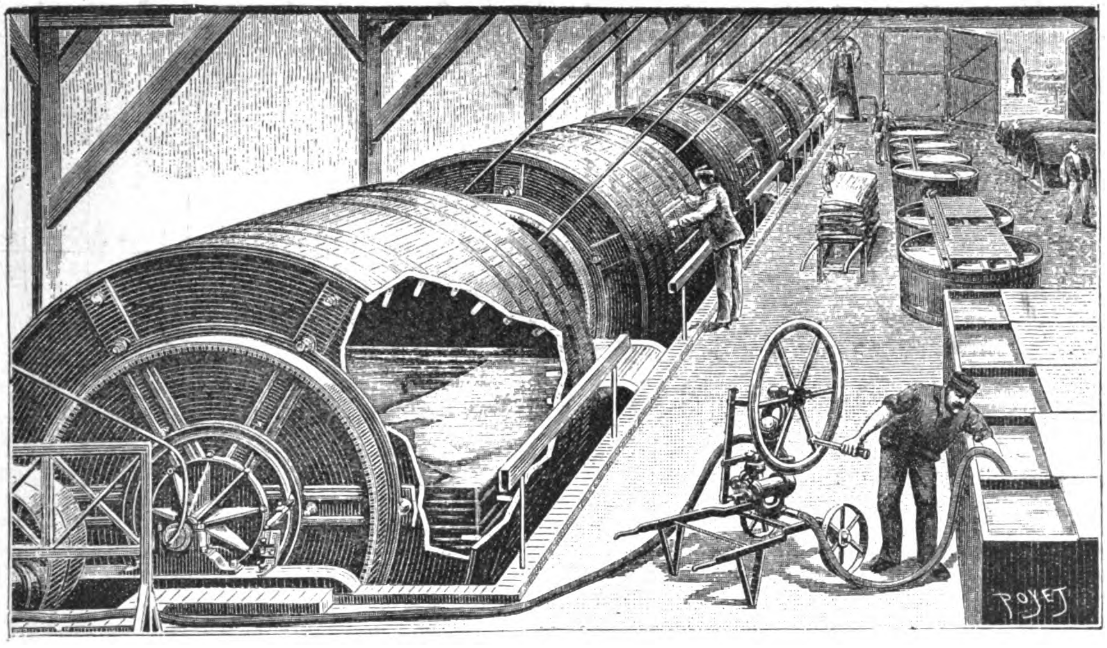
(4.) The existing meaning of the word, term or phrase being thus disposed of, there should then follow a statement of the different senses in which such word, term or phrase has been employed during different periods and such differences as herein pointed out should, if the space permit, be supplemented by extracts from contemporaneous literature.

As to the statement of Mr. Benjamin that "a dictionary which sets forth the views we take to-day, becomes inaccurate to-morrow and perhaps wrong next year," there can be no contention, but I will ask whether it is only of the electrical dictionary that this can be asserted?

Franklin Institute, Philadelphia, Pa.

TANNING BY ELECTRICITY IN PARIS.

Some time ago we drew attention to the process of electric tanning, which had been brought out in France, and in which the method of Messrs. Worms & Balé was employed.



Electric Tannery in Paris, France.—Worms & Balé Process.

Since that time a number of tanneries have been fitted up with the electric system, and in a recent number *La Nature* describes and illustrates that of Messrs. Brion & Dupré, in Paris. The process, it will be remembered, consists in the employment of electricity in connection with rotating drums which place the skins in direct contact with the tanning liquors. By this combined action of electricity and rotation a continual renewal of the surfaces is brought about, and the tanning process is greatly expedited.

The principal point was the adaptation of revolving cylinders with suitable means for obtaining a regular and continuous passage of the current, and it was for the lack of such means that former attempts at the solution of this problem failed. Messrs. Worms & Balé have solved the problem by attaching to the periphery of the drum two metallic rings, connected with circular conductors placed on the interior of the drum, as shown in the accompanying illustration. These conductors receive the current by two elastic brushes bearing against the two rings of the drum and connected to the poles of the dynamo.

The inventors make no secret of their formula. Into each rotating drum there are introduced 500 litres of filtered water for every 100 kilograms of skins to be tanned, one kilogram of bark extract at 20° Beaumé per kilogram of skins, and, finally, the necessary quantity of skins to be tanned in proportion to the figures given above. Whatever be the tanning substance employed, either in the form of liquor or bark extract, as soon as the drum has received the proper quantity it is hermetically sealed and started into rotation, and the current turned on.

The time of working is the following, according to the nature of the skins to be tanned: Ox, cow and steer hides, ninety-six hours; horse and heavy calf skins, seventy-two hours; medium and light skins, forty-eight hours. The importance of the results obtained will be apparent when it is considered that there is accomplished in ninety-six hours, by the electric method, what would require from seventeen to eighteen months by tanning in a vat, and from five to six months by the process of agitation. The electric operation is accomplished without the generation of any bad odors, and almost without noise, and with remarkable precision and regularity. The skins obtained have shown themselves, according to good authority, at least equal to those obtained by the old method.

The nature of the action going on in the electric process is quite simple.

Prof. Silvanus P. Thompson considers that the skins act like accumulator plates; that is, they constitute, as it were, enormous porous electrodes upon which the gases are liberated and which are susceptible of absorbing the gases arising from the electrolysis which takes place. At the same time the well-known phenomena of osmose take place; the capillarity of the cells of the skins being modified or interrupted, the cells are emptied of the liquors which they contain and these liquors are replaced by the tanning liquors which, placed in contact with the interior of the skins at innumerable points, produce a transformation of the hide with remarkable rapidity. The electric process is being worked not only in France but also in England, Portugal, Brazil, Argentine Republic and the United States.

The Denver Electrical Association has been incorporated for educational and technical purposes by W. J. Barker, C. K. Heasley, F. Sturges, W. D. Tyler and C. F. Hart.

THEORETICAL ELEMENTS OF ELECTRO-DYNAMIC MACHINERY—VIII.[1]

BY

A. E. Kennelly

THE INFLUENCE OF IRON IN AND ON THE MAGNETIC CIRCUIT—*Continued.*

If we next consider circuits partly composed of non-magnetic material, and partly of iron, we have to add one more link to the chain of consequences, and take into consideration the demagnetizing influence of the iron on itself. The M. M. F. induced in the iron establishes its own local magnetic circuit independent of the prime system, and its flux on the returning path that completes this local circuit, entering the iron in the reversed direction, tends to neutralize the excitation of the prime flux. The induced M. M. F. reached in the iron at each point is such that it is just $\mu - 1$ times the resultant of the prime and induced counterflux.

Figs. 16 and 17 represent the effect of placing in a uniform flux, a soft-iron bar 50 cms. long, and 20 π square cms. in cross-section. The prime distribution of equipotential parallel planes is indicated by the dotted lines 10 cms. apart, and since the gradient is 10 ergs-per-unit-pole in this distance, $B = 1$, from left to right. The bar C O D is now introduced with its axis parallel to B. If the value of μ for the iron composing it, with $H = 1$, happened to be 2001, the induced distribution of potential would be approximately that indicated by the closed curves to the scale of inverted numbers. The external potentials are indicated only from + 700 to — 700. By rotating the diagram about the axis A O B, these curves will generate the corresponding equipotential surfaces. Within the bar the equipotential surfaces would be planes perpendicular to the axis with $B = 2001$ from left to right. Outside the bar the flux completes the local magnetic circuit of the induced system by curved diverging paths from right to left.

The induced system would be similar to the straight solenoid or helix in Fig. 4 discussed in Chapter III, and the bar with this distribution could be replaced by a solenoid of the same dimensions without iron, and having $\frac{2000}{4\pi}$ current-turns per cm. or $\frac{100000}{4\pi}$ current-turns in all. But the bar could never attain this distribution, owing to the counteracting influence of its own external return flux. There is no magnetic insulator which will keep this return flux outside the bar, and it penetrates the iron with an influence equal to that of prime flux with the same intensity. Thus where the surfaces of 700 and 300 ergs cut the bar, they are rather less than 5 cms. apart. The mean value of B in this length will be $\frac{700 - 300}{5}$, or, 80, due to the external flux, or 80 times more powerful than the prime flux to which it is opposed. This demagnetizing influence would be most active near the extremities of the bar, where the external fall of potential is most rapid, and least near the centre. The result will be that the flux induced in the bar instead of taking the value $H(\mu - 1)$ which we know it would assume if there were no counteracting return flux—that is, if the bar formed the core of a closed circular solenoid—rises to the value at which it is $\mu - 1$ times the local H or resultant of the prime and induced distributions. Even if the prime flux be uniform, the induced return flux will generally vary from point to point, and the value of μ corresponding to their resultant or combination, will also be in general a variable, so that the induced system in the iron usually becomes very complex.

In the case of Fig. 16, we may, for the sake of illustration, waive all attempts at accurately depicting the resulting induced system left in the bar under the combined

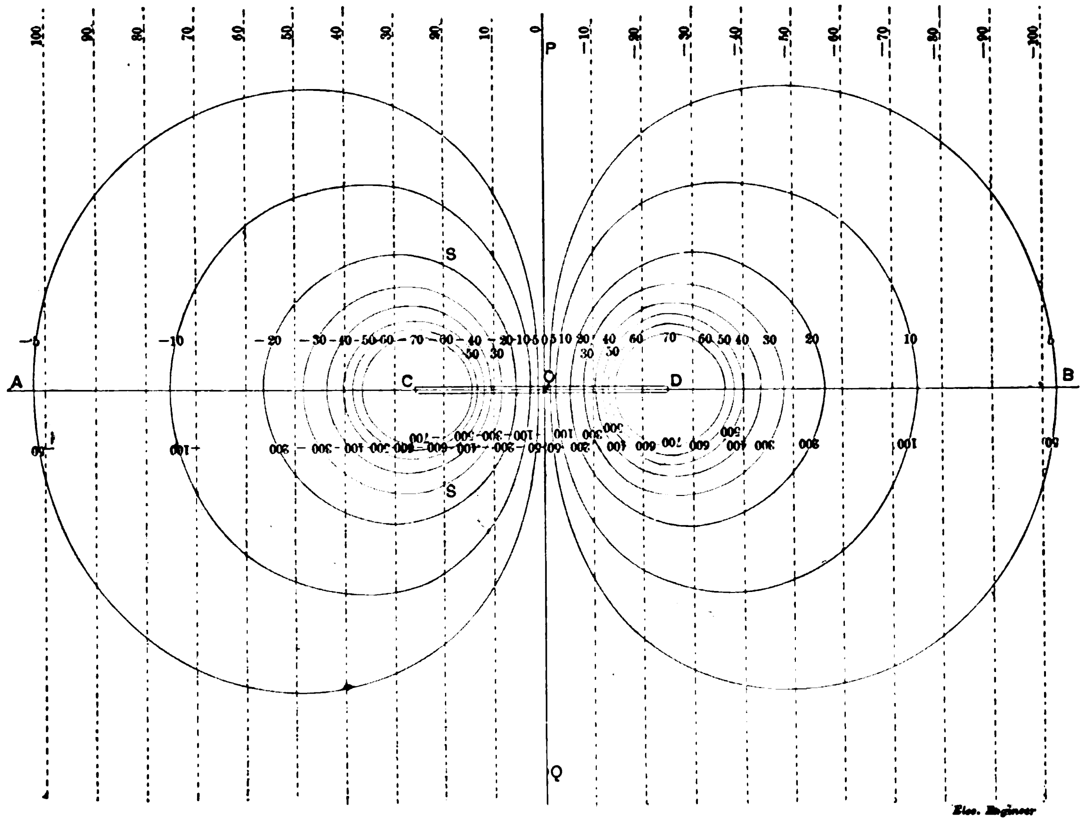


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Fig. 16.

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[1] *Copyrighted, 1892, by A. E. Kennelly.*

influences of the prime and its own return fluxes. We may assume that the relation of μ to varying values of H, as determined by experiment, may be such that the modified potential is everywhere 10 times less than the unmodified potential would have been, in which case the same distribution of equipotential surfaces here indicated will apply, the scale being altered to the upper numbers. This is the final condition of the induced system, and is independent of, although superposed upon, the prime system. If we add together at all suitable points the potentials of the prime and final induced systems, we obtain a new series of equipotential surfaces represented in Fig. 17. For instance, the points S S situated on the prime plane of + 20 and the induced surface of — 30 will have a resultant potential of — 10, and the surface of — 10 in the resulting system passes through them. Here the dotted lines still indicate the prime equipotential planes, and the curved lines the resultant system.

Notwithstanding the arbitrary manner in which we have simplified and chosen the final induced system, this diagram fairly represents the general effect of introducing a bar magnet or rod of soft-iron into a uniform field.

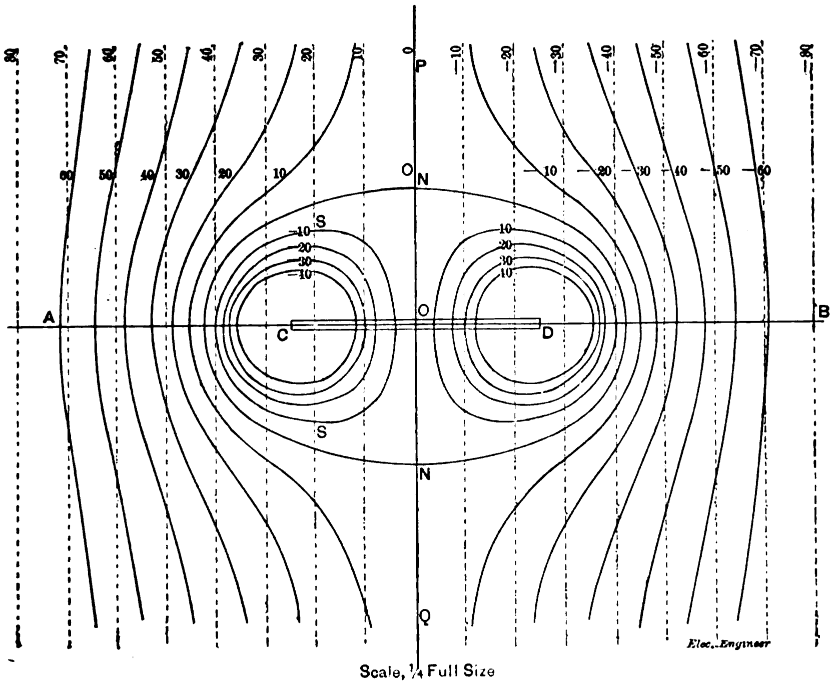

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FIG. 17.

Broadly, the prime equipotential surfaces are displaced, as an elastic medium might be, by the introduction of a wedge. The flux is intensified along the line of the axis, and weakened in the neighborhood of the equatorial plane. The surface of zero potential has two sheets, one in the equatorial plane, and the other an ellipsoid enveloping the bar. At their intersection N N a neutral circle is formed, obtained by revolving the radius O N round the axis A O B. At all points on this circle the flux vanishes, and a small compass needle would not assume any selective direction. That is to say, on this circle, the prime flux from left to right just balances in intensity the return flux of the local or bar circuit, from right to left.

In the above instance we have considered the case of a long, straight and narrow bar placed lengthwise in a uniform flux; but the removal of these restrictions, while it may add numerical complexity, brings no additional intricacy of process. In all cases we have first to determine, from the currents and their geometrical arrangement, the elements of the prime system with the iron removed. Then introducing the iron into the circuit, the final induced system has to be found, such that at every point the induced M. M. F. is (μ — 1) times the value of the resultant intensity due to prime and induced distributions, μ being a function of the intensity experimentally determined. We might consider the iron as divided up into bundles of rods arranged everywhere parallel to the flux, and find the distribution round one rod at a time as though that existed alone, and then superpose the successive distributions from neighboring rods, extending the process until every rod had its influence compounded. Or it might be possible to deal with the iron in mass by some more comprehensive method that would render this long summation unnecessary; but the final induced system, however arrived at, when superposed upon the prime distribution would yield the resultant system actually developed in the circuit.

On the removal of the prime system, the induced system is left active, but the iron, no longer submitted to the prime excitation is exposed solely to its own return flux tending to reduce the residual M. M. F. The demagnetizing influence will vary from point to point, depending upon the distribution of potential and flux in the induced system; but wherever the demagnetizing flux exceeds a certain intensity depending upon the quality of the iron, a process of decadence will set in. The induced system may be destroyed in a small fraction of a second, or it may be sustained nearly complete for an indefinite period according to the range of μ in the iron, and the form of its circuit, which latter regulates the intensity of the demagnetizing return flux.

These conditions of magnetization in iron are readily apprehended qualitatively, but they are numerically so complex that the elements of a magnetic circuit partly composed of iron, cannot in general be computed. They have in fact only been determined in a few simple cases, and usually on the assumption that μ has a constant value.

It is evident that from the standpoint of magnetic circuits, a magnet is equivalent to a particular form of active solenoid. A piece of magnetized iron is physically very different from a conductor carrying a current, but magnetically it is a particular aggregation of small magneto-motive forces and as such the corresponding arrangement of conducting loops must always exist.

Ewing's theory is the most recent and comprehensive hypothesis accounting for the magnetic behavior of iron. According to this view, every molecule of iron may be regarded as an elementary independent magnet, free to set itself in any direction under the influences of magnetic flux. Each molecule has a separate magnetic circuit, in which the M. M. F. is inherent and fixed. The flux from any one molecular magnet, while extending over the whole system, will be practically confined in its action to those molecules in closest proximity. The result of all the mutual actions will be an aggregation of magnetic circuits in all directions and degrees of complexity, so that the resultant M. M. F. in any one line is zero. The iron is then neutral. If a gradually increasing flux is brought to bear upon the system from an exterior M. M. F., at first only a few molecules in balanced or unstable equilibrium will be affected and turned into alignment with the flux. Gradually molecules in firmer mutual association will be separated from the configurations they had naturally assumed, and brought into more or less direct alignment with the impressed flux. There will be a certain strength of flux which will suffice to destroy a large majority of all the groups. At this stage μ will reach a maximum value. Beyond this point only the more powerful and enduring arrangements will remain to be reduced, as well as the more perfect alignment of those already mastered, while a few of the most powerfully united groups will require comparatively great intensities to resolve them. At an indefinitely great intensity, every molecule will be brought into parallelism. In this condition, the M. M. F. induced in the iron will have reached its maximum, and be equal to the sum of all the molecular M. M. F.'s in any one line. At any intermediate stage, the induced M. M. F. would be the sum of the M. M. F.'s now more or less dispersed, resolved along this line, the components at right angles to the flux disappearing in the aggregate by cancellation.

Besides offering explanations for a variety of magnetic phenomena, this theory accounts for the observation that μ does not merely depend upon the magnitude of the prime intensity H, but also upon the manner in which this magnitude has been reached; for the molecular disengagements will generally differ if this value be attained by steady increase, by reversals, or again by overreaching and descent, so that the condition at any moment involves the previous history of the iron, or gives evidence of what has been termed its "magnetic memory." We shall return to this subject at a later period.

In most electromagnetic machines, the magnetic circuit is principally of iron, and consequently approximates to the type of a closed solenoid with iron core. This greatly facilitates the computations, for although there is some return flux, whose influence prevents an accurate determination from being arrived at, unless experimentally, yet the demagnetizing flux is generally small compared with the prime excitation, and a sufficiently close approximation to the resulting magnetic circuit is usually available to meet practical requirements. It is only when the circuit has a lesser proportion of iron and larger air-gaps, that the numerical difficulties in determining the resulting system become formidable.

A USEFUL INCANDESCENT LAMP DIAGRAM.

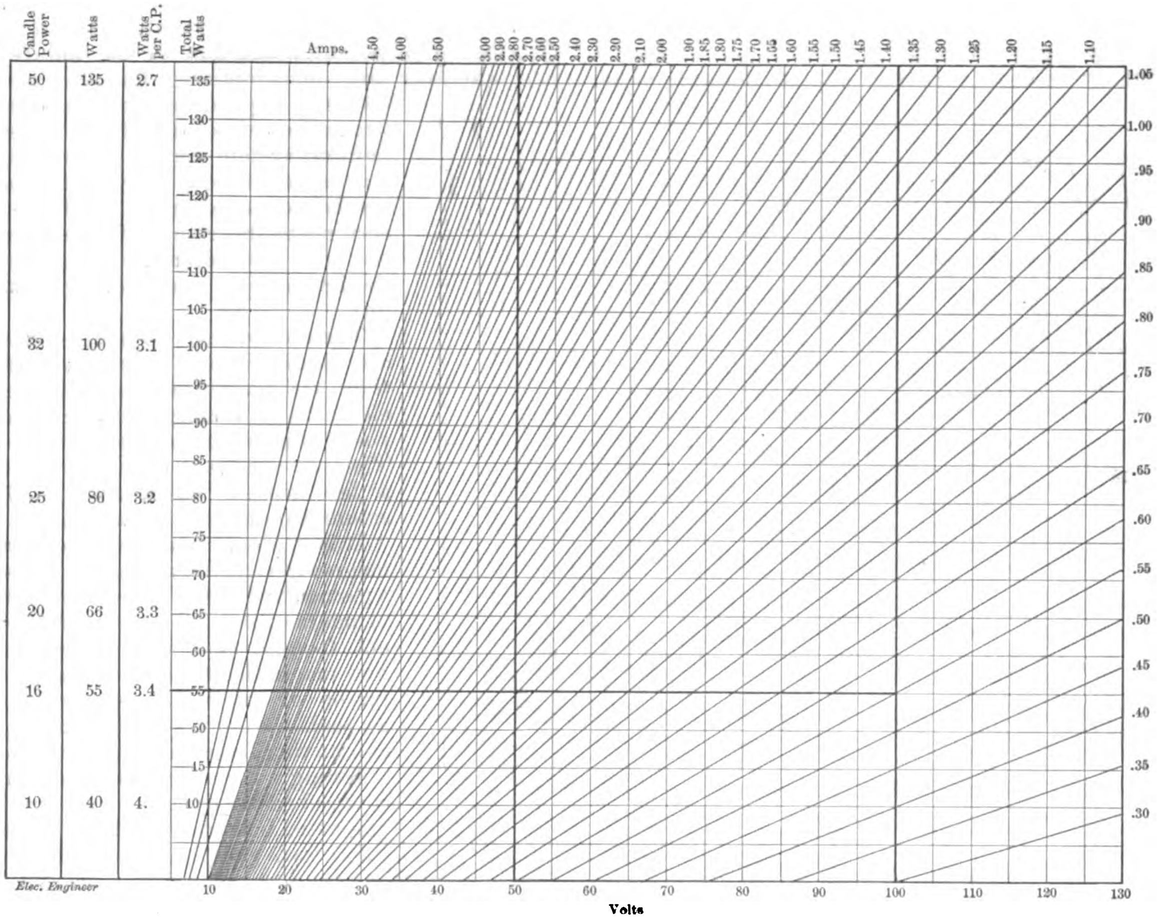
BY

E. V. Roberts

THE accompanying diagram devised by the writer will be useful when considering lamps and also for other purposes.

The first vertical column gives the candle power; the second, the total watts taken as the standard for such candle power, the third, the watts per c. p. for such a standard; the fourth column, the total watts.

In order to obtain the amperes corresponding to any total watts for any desired voltage the line indicating the total watts is followed horizontally until intersection is made with the vertical line indicating the desired voltage, and the diagonal line intersecting at such point gives the amperes. Heavy lines are drawn through 55 watts (the standard taken for 16 c. p.) and 50 and 100 volts. Of course the total watts for a given c. p. will often not be in accordance with the standard shown, 16 c. p. lamps being ordered of from 50–65 watts.



ROBERTS' INCANDESCENT LAMP DIAGRAM.

Example No. 1 —Given a 54-volt 55-watt lamp, what "C" will it take?

Answer.—Follow the 55-watt line to 54 V. The diagonal is almost half-way between 1 and 1.05; hence 1.02 ampere.

Example No. 2.—Lamp, at c. p. desired, 110 volts; 85 amperes. Find the total watts.

Answer.—Intersection of .85 ampere and 110 volt lines gives 93.5 watts.

ELECTRICITY IN BITUMINOUS MINING.[1]

BY ELMER A. SPERRY.

MANY a traveling Englishman on this side turns his eye-glass upon a swift succession of passing trains laden with barely a day's product from some unheard-of Western colliery, and thinks that he instinctively recognizes pit coals from Northumberland or Lancashire. He supposes "all coals come from Newcastle;" nor is this surprising. The average Eastern men may be said to be almost unaware of the existence of bituminous fuel. To him anthracite is coal, and Pennsylvania is the place of its nativity. Yet last year 150,000,000 tons of bituminous coal were mined in the United States, principally in the West.

The problem of replacing manual labor in coal mining has engrossed the labors and thought of the ablest engineers of the age. Some of the earliest patents granted by the English monarchs were for mechanical mining devices with an avowed object of superseding manual labor. These machines were driven by animal or hydraulic power, and more recently by steam and compressed air. They sawed, scraped, cut and plowed, but principally struck a blow. Many, even to a recent date, swung a pick provided with the ordinary transverse handle or power connection. Few if any of these machines have been successful under the severe duties required, and none have withstood the test of time. Machines generally employing cutting or scraping devices are of limited application. They are worked with success where the vein is clear; but this, however, is the exception. The presence of iron pyrites or other foreign substances in the strata quickly dulls the knives and requires such heavy driving powers as to preclude commercial use. I have witnessed the operation of this type of machine in strata excellently adapted for machine mining except for a frequent deposit of sulphur about the thickness of a silver dime. The cutters being made of the finest Mushet steel, the entire set required changing every 40 square feet undercut. The current readings would show a power consumption on an average of 27 h. p., whereas in clear coal 10.5 h. p. only were required, and one change of cutters for each 250 square feet undercut.

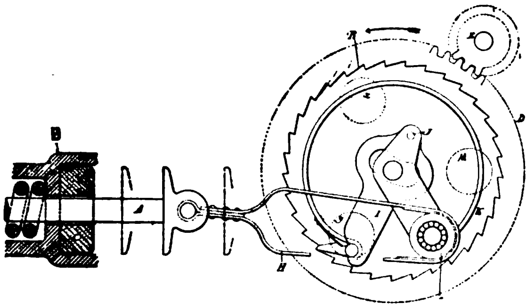


FIG. 1.—SPERRY DIRECT BLOW MINING MACHINE.

The author then described the usual methods employed in mining bituminous coal, and then proceeded to describe the machines designed to carry out these methods.

I have thus briefly pointed out the methods employed that the conditions may be better understood in the discussion now to follow of electrical machinery as adapted for use in such mines. A diagrammatic outline of the direct-blow machine is shown in Fig. 1, the completed machine being shown in Fig. 2. In this form of machine a bi-wheeled truck furnished with handles at the rear, is provided with a continuously operating electric motor of about four horse power, connected by gearing to a catch or retractor, a longitudinally moving heavy projectile with a pick secured to its outer extremity is surrounded by a driving spring of about 125 pounds per inch compression. The line of movement is practically through the centre of inertia of the machine. These springs are preferably made in sections, and initial pressure is given of about 500 pounds. A retraction then takes place of from 6¼ to 7½ inches to a pressure of 1,375 pounds, whereupon it is released and allowed to make a vigorous forward stroke. This process is repeated from 160 to 225 times per minute. The mean effect of this type of machine is 935 pounds when allowed to strike the cushion, and when striking the work at a distance of one inch from such cushion giving 1,000 pounds mean effect. This is shown in the spring curve diagram Fig. 3. The mean effect in air machinery employed for the same purpose is between 400 and 450 pounds, a 3½ inch cylinder being the largest employed. The current required for the operation of this machine is between 10 and 10.2 amperes at 220 volts. The projectile weighs between 100 and 150 pounds in the different sizes of machines.

Early in the development of this machine it was found that under the action of the intense concussion resulting from the percussive blows and shattering strains throughout the machine, a motor to last under such conditions must be essentially different in its organization from the ordinary commercial machine. After working along various lines it was at last found that by mounting the driving pinion loosely upon the armature shaft, providing it with wing-like projections between which and the armature shaft elastic cushions such as blocks of rubber could be inserted, the trouble could be averted, and when adopted it was found that the repairs on armatures were reduced to a small percentage of their former value. An elastic medium was also employed in the commutator to allow for the difference in expansion of the insulated copper segments and the steel commutator shell. Numerous driving keys or fins, consisting of rawhide, were set in the periphery of the armature and allowed to protrude for the purpose of securing the coils against circumferential displacement. The fields were not found to give trouble. With this construction of armature a large number of machines have been made and run successfully in mines in Illinois, Indiana, Ohio and Kentucky. In most instances these machines are run constantly night and day.

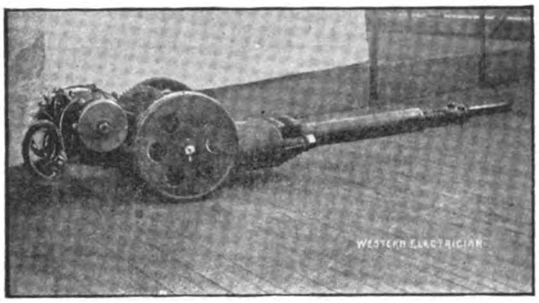


FIG. 2.—SPERRY DIRECT BLOW MINING MACHINE.

A detailed report of each day's work of these machines has been kept from the very first, stating the exact nature of any repairs, the name of the "machine runner," the number of feet undercut, hours' work, etc. These reports are kept on file, and have been of great value in aiding to eliminate the troubles developed. In Ohio alone these reports show that upward of 550,000 square feet of coal strata have been undercut by this type of machine. A somewhat larger amount than this has been excavated in Illinois. In the States of Indiana and Kentucky the operations have not been of so long duration, but at present the daily cutting in the latter States exceeds those in the former. Besides the elasticity introduced in the armature gear, elastic cushions have also been introduced between the retracting device and the main gear which is found to still further reduce the shock to the machine.

At an early date it was found that a machine capable of storing in each stroke of the heavy projectile as great an effort as is required for rapid and effective cutting must of necessity be heavy to be capable of backing up the blow without serious recoil, yet the machine on the other hand should be light for easy handling and direction by a single operator. With a light machine it is found impossible to allow the cutter to strike the work sufficiently back in the stroke for its required penetration, without serious effects from recoil. The operator would complain bitterly of the machine running back upon him, jerking him about upon the floor of the mine, making accuracy of direction impossible, and yet lightness of the machine is important. To combine both qualities I devised a cycle of operation shown in the diagram, Fig. 3, the object being to immediately start upon the act of retraction at the moment the projectile had been arrested by the

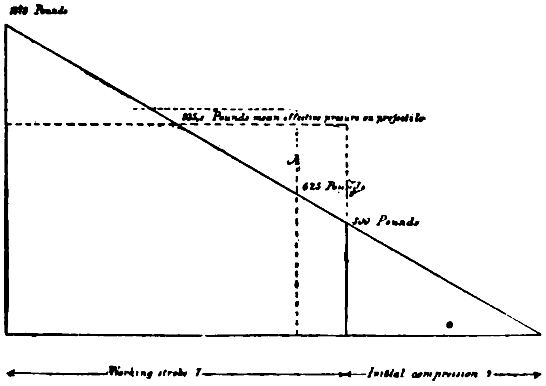


FIG. 3.

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[1] Abstract of a paper read at the general meeting of the American Institute of Electrical Engineers, Chicago, June 6, 7 and 8.

work. no matter at what point in the stroke, eliminating thereby the time element necessary for overcoming the inertia of the body of the machine and starting it backward in recoil by the intense backward spring pressures. The details are simple and will readily be understood. The projectile *A*, Fig. 1, is forced forward by the spring *B*; a cushion *C* relieves the shock when the projectile is not otherwise intercepted. A gear wheel *D* is constantly driven in the direction of the arrow by the motor pinion *E*; this wheel is provided with internal ratchet teeth *R*. A crank *G* is mounted entirely free from the wheel and co-operates with a long slotted pitman *H* connected with the projectile for retracting the same. A light steel crank arm is pivoted entirely free of the wheel *D* and an auxiliary arm *I* provided with a dog co-operating with the ratchet teeth *R*, is pivoted to the main crank arm at point *J* and connected with the crank arm through the circular steel spring *K K*. When the crank *G* reaches the back dead centre at point *m* a reversal of the strains and a free forward movement occurs in the direction of the rotation of the wheel, but very much faster under the impetus of the heavy compression of the driving spring *B*, the pitman and both portions of the crank moving forward together. Suppose now that the forward stroke was intercepted at point shown in dotted line near the letter *A*; at this moment the crank *G* would be found in the position *X* also shown in dotted lines, but its momentum and the slot in the pitman would instantly allow it to take up position *Y* also shown in dotted lines, being at an equal angle on the opposite side of the centre. Its further progress would be intercepted by the remote end of the pitman and at this instant the dog would instantly fall in the next tooth in the revolving wheel *D* immediately commencing its work of retraction without the necessity of the full stroke of the pitman being accomplished. The work of the percussive blow is fully accomplished before full retardation, and while being intercepted. Nothing is accomplished by standing and pushing against the face so that its immediate retraction is not found to interfere in the least with its effective operation, but on the other hand is found to eliminate entirely the serious effects of recoil upon the operator, allowing a light machine to be easily and completely directed while at work. Modifications of the details have been employed, but the general principle has been found to work extremely well in practice. The machine efficiency from the current on the one hand, and the blow of the pick upon the other has been found to be in excess of 70 per cent.

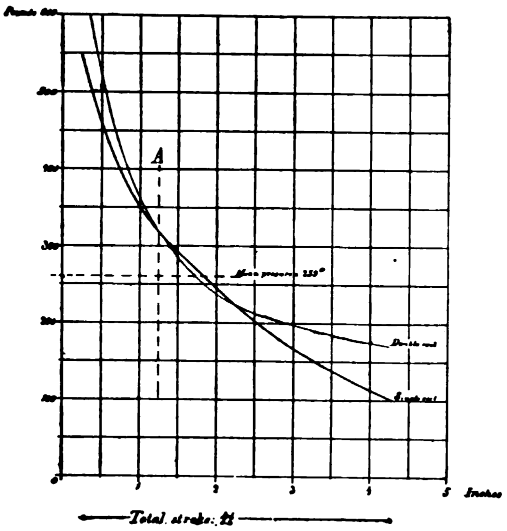

FIG. 4.

Another form of the direct-blow machine has been constructed operating upon the solenoid plan; two and three solenoids have been employed in various combinations. It has been found that the return of energy was extremely small until an approximately closed magnet circuit was reached. Another point found was that the effectiveness of the blow was materially decreased if the magnetic circuit was closed beyond a certain point, the reciprocation of the solenoid core being dependent upon the non-closure of the magnetic circuit. Diagrams were submitted, showing the various mathematical functions of the machine.

The pressure obtained in case of both single and double coils are shown in Fig. 4. Fig. 5 indicates the general arrangement of the solenoid machine. The total weight was about the same as the weight of the spring-actuated machine, and the energy absorbed somewhat in excess. The mean effective pressures, however, are not nearly as great, as diagram Fig. 4 indicates; especially is this the case when the work was intercepted, say one inch from the end of the stroke, as at point *A*, in this diagram; the mean effective pressure falls from 259 to 210, decreasing, instead of increasing, as in the case of the spring machine. It was possible to recover in the solenoid machine nearly 10 per cent. of the energy expended during the first few minutes, but the heating effect was found to seriously interfere with its protracted operation.

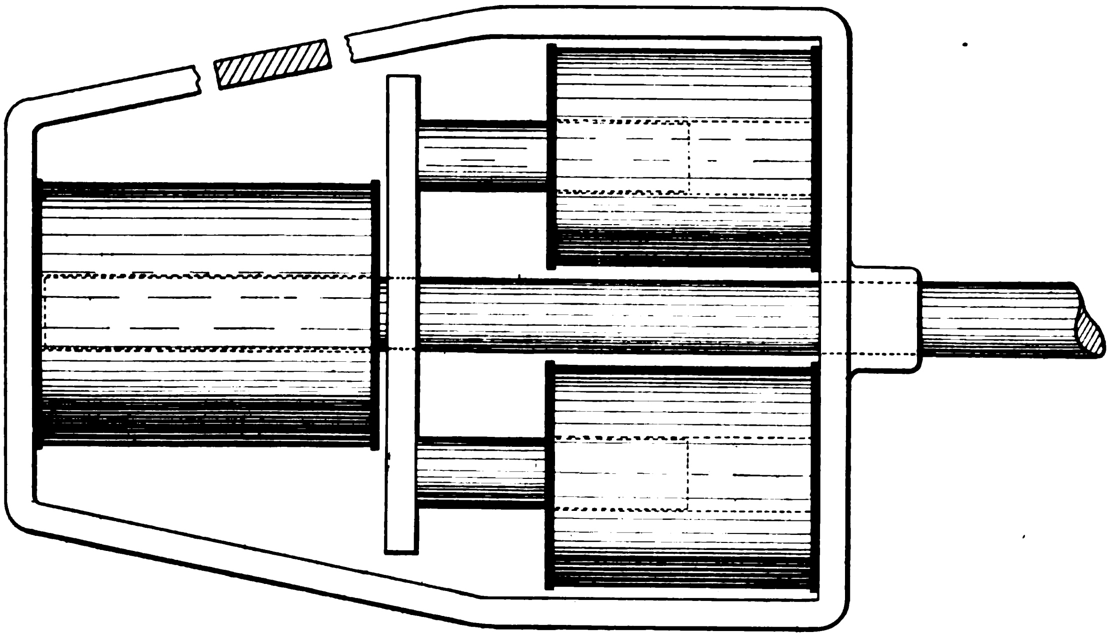

FIG. 5.—SPERRY SOLENOID COAL MINING MACHINE.

In drilling holes for blasting, an auger machine is used, as shown in Fig. 6. In this case the auger is driven by a single-reduction motor, the rod holding the auger being provided with a featherway for driving and a screw-thread for the feed. An automatic attachment is placed upon the nut of this screw feed, by means of which, when sulphurs or other foreign substances are encountered the feed is automatically relieved, the progress being inversely to the density of the strata. The machine is made light, and is usually fastened from roof to floor. One machine will drill about fifty holes 6 feet deep per shift of nine hours. The speed of its penetration in ordinary coal is about 3½ feet per minute. It requires about 3½ amperes at 220 volts. Both this and the pick machine are provided with a starting rheostat combined with or located interior to a cable reel which accompanies each machine. The flexible cable reaches back from the machine to the wires in the entries. The core of this cable is small, and although insulated clamps have been persistently shipped, secured to the ends of the cable for its attachment to the entry wires, it has been found that the miners almost invariably cut them off and prefer to simply bend the end of the cable in the form of a hook, and hang it upon the entry wire. This allows of their being readily pulled off upon the completion of the work without the necessity of going back to the mouth of the room, and at the same time seems to provide all the contact required.

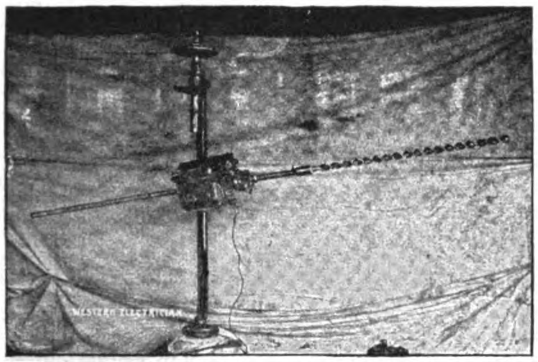

Fig. 6.—Sperry Electric Mine Drill.

As to other machines it may be stated that they are divisible into two general classes—the revolving cutter and the chain machine. In the former the cutters are secured to a revolving bar, which is forced against the substance to be cut. In the latter the cutters are inserted in a chain running over suitable sprocket wheels fastened to a frame, which extend under the coal supporting the entire cutting organization. The chain as it passes out from the coal goes around a driving sprocket from which the power is obtained. Many attempts at the construction of the former class of machines have been made, which have resulted in entire failure.

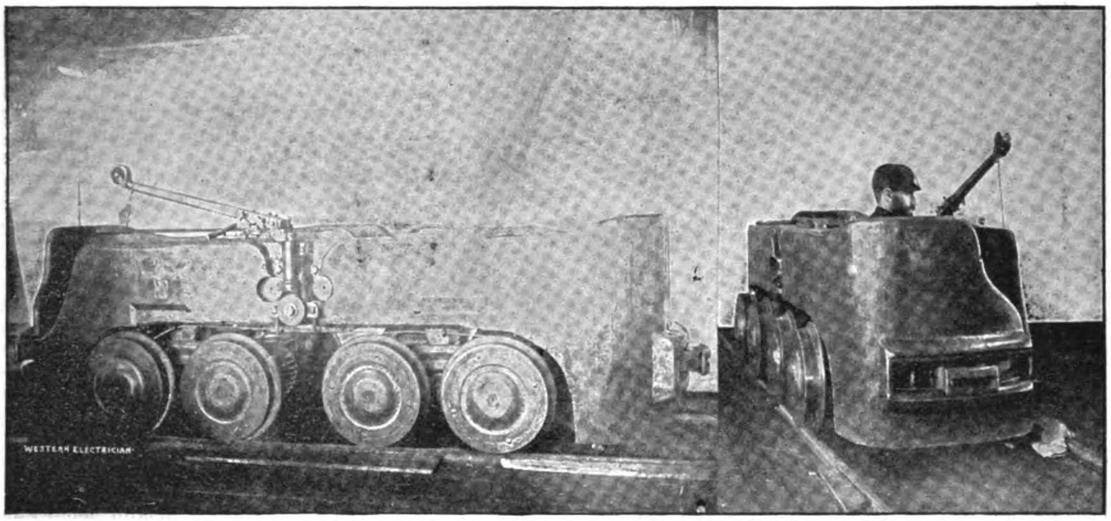

Fig. 8.—Sperry Coal Mine Electric Locomotive.

The extremely small amount of room between face and props in the longwall mines sometimes precludes the possibility of even using a very short reciprocating machine. I have therefore resorted to another form of machine, Fig. 7, to be used in connection with this style of mining, consisting of a mechanism about 5 feet in length, about 20 inches wide and 18 inches high, from the side of which protrudes a cutting device operated by an electric motor forming part of the machine. This is organized to travel along the face and undermine to a depth of three feet, usually working in the strata below the coal known as "fire-clay."

A number of these machines are in daily operation in the northern district of Illinois. A single machine has repeatedly undermined as high as 1,500 feet per nine hours. The machine weighs somewhat over a ton and travels upon a rail located at one side, which at once provides support for the machine, means for providing against the twisting strains of the lateral cutting device and providing at the same time for feeding in either direction. These rails are in sections, and are taken up after the machine has gone over them, are passed to the front over the machine on rollers provided for the purpose and are laid ahead. The pintles used to connect the rails form, with the other pintles, members of a series by means of which the feeding along the rail is effected in a simple manner, and one that has proven successful in actual work extending over a considerable period of time. These machines have been in use upward of two years. They require 22 to 35 amperes for their operation at 220 volts. Flexible cable of 150 feet is provided, which, being attached to the live wires ahead, allows the machine to cut 300 feet before readjustment is required.

After the product has been loaded and the cars massed in trains, their transit to the surface is a problem that has received considerable attention from the mining engineer. After describing the various methods of hauling, by means of cable, and difficulties encountered the author continued:

Electric haulage has been looked upon by the foremost operators as the coming system, and one which is destined to solve the problem of economical transfer of the heavy product in mines.

After considering the problem I have designed several motors, one of which is shown in Fig. 8. A number of plants containing this motor are now in daily operation in Ohio, Indiana, Kentucky and in this State (Illinois). Two of these plants have been installed in one mine in Illinois. Profiles of the entries in which these cars are in operation show grades as high as 7 per cent., 5 per cent. being not unusual.

In designing the locomotive I have employed eight drivers grouped in two swiveling trucks free to turn on the shortest radius curves—as short, in fact, as 9 feet radius, measured from the centre of the track. A single powerful motor constituting the frame of the car is coupled to all eight of these drivers, the coupling being simple and of such character as not to be interfered with in the least by the change of alignment between the truck and the car body upon irregular track or in making curves. This, while being rather a difficult problem, has been successfully worked out, as shown by the fact that none of the locomotives have ever required repairs as to this portion of their mechanism, although the first has been in operation about two years. Fig. 9 illustrates the central feature. Steel tires of a special grade are employed on all the drivers, and the fact that they are driven from a single motor insures absolute uniformity and harmony in their peripheral speed. It is to this fact, as recently stated in a paper before the Chicago Electric Club, that I attribute the extremely satisfactory results in traction which have been observed,

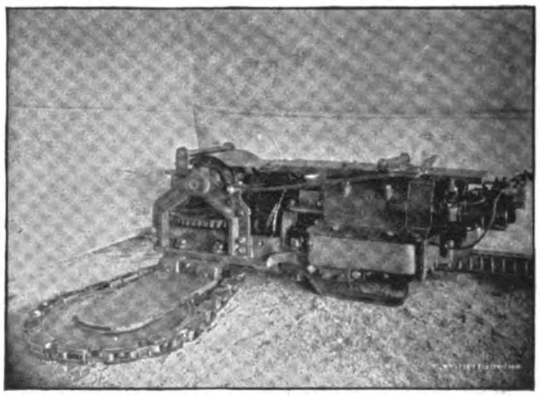

Fig. 7.—Sperry Coal Cutting Machine.

it being demonstrated both in shop tests and other conditions of actual service that two motors without mechanical coupling do not show results that are at all comparable. In regular service as high as 25 per cent. of the weight of the entire machine may be depended upon for draw-bar pull, and considerably over one-half of such weight has repeatedly been shown on the dynamometer. The wheel base is entirely flexible, distributing equal portion of the total weight upon each driver under all conditions of irregular track. The trains hauled by these locomotives frequently have as high as 200 wheels upon the track. The pit car wheels are constantly oiled, distributing an excellent lubricant from one end of the track to the other, and I have found for rapid acceleration work on heavy grades, and quick action of the brakes that sand is almost as indispensable as the current itself. In using the rails as return the sand is found to seriously interfere with the proper electrical connection to the rail, especially where four wheels only are employed. It is the usual practice in this case to use sand upon one side only, giving a torsional working strain which tends to seriously rack the frame, increasing the flange friction and giving uneven wear upon the drivers. With eight wheels, however, I have found it preferable, and in fact this practice is followed in all installations, to sand upon both sides and obtain the "bite" upon the rail through the silicates from at least six drivers out of the eight. The sand, by the time three wheels have passed over it on either side is sufficiently broken up to allow the fourth pair to get a fairly good contact with the rail for electrical conductivity. This is an accidental feature in the use of the eight-wheel car which is of great value. The machines themselves are low and narrow, the height being between 34 and 36 inches, accommodating themselves thereby to the lowest entries. Three sizes have been built, namely, eight, ten and twelve tons, Fig. 8 showing the latter. The motor of the largest of these is of 125 h. p. capacity; 250 volts is the highest that has been used in connection with the machine. The temperature of the machine is very low, not exceeding 60 degrees above the atmosphere on a ten-hour run. These machines have been operated on as low a rail section as 10 pounds with fairly good results. The heaviest rail that has ever been employed in connection with them is 20 pounds. This makes an extremely inexpensive track, not only eliminating entirely the *light track* argument used against electricity by advocates of rope haulage but "sees them one better" in that a single track with the most abrupt curves serves better purpose than double track with rope. In Streator No. 3 shaft of the Chicago, Wilmington & Vermillion Coal Co. a round trip on a haul of 7,000 feet, including switching at both ends, has been repeatedly run in 8½ minutes, part of the entry being a 3 per cent. grade against the loads. Thirty-seven pit cars of about two tons gross weight have been handled on this grade. The controlling mechanism is extremely simple, a single hand wheel serving the purpose of start, stop, acceleration and reverse. A rheostat and series fields are used. The rheostat is of most durable construction consisting of iron and asbestos. The trolley wire is upon the roof and follows the line of the track at a distance of about six inches outside of the gauge line of one of the rails. Excellent results have been obtained by the use of an elastic medium located between the trolley wire and the solid mine roof, one form used being among the exhibits. The elasticity prevents concussion of the rapidly moving trolley, obviating thereby the serious sparking often, and most easily observed in mine entries where nothing but the most intense darkness prevails. To my mind the extreme facility with which electric power can readily be transmitted by the mere contact between conductors, has no parallel in any branch of physics. I have often observed the simple contact between trolley wire and wheel while 160 h. p., namely 480 amperes, were being transmitted to the motor, each of the eight drivers slipping vigorously on the sanded track, throwing fire which illuminated the surrounding mine walls, while the trolley with the exception of slight infrequent scintillations was perfectly dark and of extremely innocent appearance.

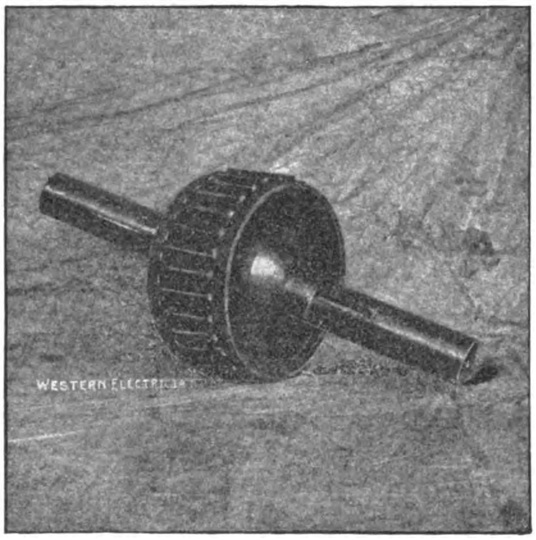

Fig. 9.

A number of special and automatic devices have been employed in connection with the system with excellent results. Powerful electric headlights are used in each end of the locomotive, and in the twelve-ton type (see Fig. 8) the end is carried out, providing a cab which entirely surrounds the motorman with high walls of metal 2 to 3 inches thick, entirely protecting him against collision, piling up of cars, falls of rock, etc. I have operated this motor on tracks which if seen by daylight would be adjudged unsuitable entirely for even the roughest mule service, handling heavy trains at a rate of speed of 2,700 feet per minute, being somewhat over 30 miles an hour. The perfect flexibility of wheel base of the motor is doubtless responsible for these excellent results. Compound-wound dynamos of about seven tons weight are used to furnish current for the machine. These are designed for sufficient excess of capacity to operate other devices in connection with the mine. In one mine at the South we have coupled to a single dynamo and engine, one of our eight-ton haulage cars, electric lights at all partings and switches, and on top in engine-room and at a store, electric mining machines of the direct-blow type, and an electric drill for blasting, by means of which machines the entire product of the mine is taken out. The mine which was formerly ventilated by a furnace, at present has its air moved by a fan driven by a powerful electric motor, and an electric pump is at present being installed, all of which are operated from the same feeder. In Kansas a mine pump raising water about 800 feet and two very extensive endless rope hauls are operated from the same dynamo as our electric excavating machinery. The pumps are of simple construction, the motor being geared to the plungers by spur gearing. It has been found with the pumps, longwall machines and drills as well as in the case of the percussion machines, that mounting the pinion loosely upon the armature shaft and driving it with cushions, located between it and the armature, has worked a decided economy in repairs, showing its adoption to be along the line of good engineering.

THE LOCKPORT CANAL.

About a year ago an association was organized in Lockport, N. Y., for the purpose of securing the construction of a hydraulic canal, 200 feet in width and 20 feet in depth, to connect Niagara River with Lake Ontario. The right to make, use, sell and transmit water, electrical and other power, and the right to furnish water to the city of Lockport, and other places, was secured, as also were written contracts for the purchase of over 2,250 acres of land. A special law was obtained authorizing the city of Lockport to contract with any persons or company which shall build the canal, for water for domestic and other purposes, at a yearly rental of $50,000. A detailed and accurate survey of the proposed canal has been made by competent engineers, showing the route, length, depth of cutting, quantities of earth and rock to be removed, bulkheads, dams, bridges, etc., necessary for obtaining upwards of 100,000 h. p., and maps and drawings have been made.

The details of the construction of the canal, as laid down in the engineer's estimate, are as follows:

Number of acres for right of way, 792; earth excavation, cubic yards, 6,250,000; rock excavation, 2,438,360; rip-rapping, yards, 91,734; bridges to be built, one double track, 80-foot span; one single track, 80-foot span; one single track, 2 spans 64 feet each; dams (four), cubic yards of mason work, 5,129; coping, cubic yards, 220; highway bridges, 80-foot span, 8; highway bridges, different lengths, 13; culverts, 2 large, 10 small; one guard lock and three bulkheads.

The total length of the canal to the head of the convenient natural gulf about a mile west of Lockport, is twelve miles, and the length of the gulf about two miles. From the gulf to Lake Ontario it is twelve miles, and a large stream which only will have to be deepened and widened in various places, connects the two, so that very little expense would be necessary below the gulf.

This gulf is midway between the river and the lake. It is from 500 to 600 feet in width, with gently-sloping sides, and from head to foot—about two miles—there is a fall of 220 feet. It is thought that four falls of about 50 feet each would best distribute and give the greatest force to the water, which is the plan indicated by the engineers, but by carrying water along either side of the gulf by raceways or pipes a fall of any depth under 200 feet can be secured.

The latest reports are such as to encourage the belief that action of a definite character is being taken looking to a speedy consummation of the plans above outlined.

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VOL. XIV. NEW YORK, JULY 6, 1892. No. 218.

It is not in human sagacity to foresee prior to experience, what simple occurrence or what neglect in arrangement may interfere with the result of an experiment.—Joseph Henry.

THE FRANKFORT-LAUFFEN EXPERIMENTS.

IT is now just ten years ago that Marcel Deprez demonstrated, in a practical way, the possibility of transmitting energy electrically with a degree of efficiency over long distances heretofore unattainable by other methods; and though the total amount of power received at Munich from Miesbach, 37 miles off, was barely half a horse power, the experiment served to show that the method, as a method, was feasible. The last ten years have more than confirmed the estimate of the results then obtained, but it remained to show how far the progress made in the modern applications of high potentials could be applied to this same problem of long-distance transmission. There were not a few who shook their heads at the thought of using 30,000 volts on a line over 100 miles in length, and subject to the many adverse conditions under which overhead lines labor. Again, the probable loss in the line itself due to its electrostatic capacity was a matter of conjecture by no means favorable to a successful issue. Again, while few doubted the possibility of constructing transformers capable of standing a pressure of 30,000 volts, the fact remained to be demonstrated. But the success of the experiments is confirmed by the official report of the testing committee, part of which is now given to the public. Taking a few representative figures among the tests, we find that with 78 h. p. applied to the dynamo by the turbine, 53.5 h. p. or 68.5 per cent. was delivered by the secondary transformer at the distant end 109 miles off; with 150 h. p. at Lauffen, an efficiency of 75.3 per cent. was reached, and with 197.4 h. p., 73.9 per cent. These experiments were carried on in all sorts of weather, and though the potential employed is not given in the tables thus far published, it is safe to say that it was probably not below 15,000 volts. Considering the fact that the transmission included two transformations in converters, together with the loss in the dynamo and in the line, the result obtained is excellent proof of the high order of construction embodied in the apparatus employed and reflects credit on both parties to the undertaking, the Allgemeine Elektricitäts-Gesellschaft, of Berlin, and the Oerlikon Maschinenfabrik, of Oerlikon, Switzerland.

WORLD'S FAIR LIGHTING.

IT is gratifying to learn that the Grounds and Building Committee of the Columbian Exhibition accepted the bond of $500,000, offered by Mr. Westinghouse on Monday, June 27, and that the contract for lighting has since been executed between the Westinghouse Electric and Manufacturing Co. and the authorities of the Exhibition. The sureties on the bond are August Belmont, Chas. Francis Adams, Brayton Ives and Marcellus Hartley, in addition to the signature of the Lawyers' Surety Co., of New York. Mr. Westinghouse is to be congratulated upon this result of the pluck and persistency which he has shown throughout in the competition and negotiation. The managers of the Exhibition have done well in securing the desired service at so low a cost.

Since Mr. Westinghouse's tender was published some weeks ago, there has, naturally, been some speculation and some expression of opinion, among electrical people touching the probability of profit or loss to the bidder on the contract. The price was something of a surprise, no doubt, in view of the much larger figures previously submitted by several bidders; but it is well to point out that the question of profit or loss properly concerns the contracting company, more than it does others or the general public. The consummation of the contract lends an element of strength to the position of the Westinghouse Company.

ELECTRIC MOTORS AS SUBSTITUTES FOR STEAM LOCOMOTIVES.

IN commenting upon the recent presidential address of Mr. Frank J. Sprague before the American Institute of Electrical Engineers, we draw attention to the very conservative attitude assumed by that gentleman in his estimate of the limits to which the electric motor was confined on the great steam roads. Mr. Sprague showed that, for the present at least, the general substitution of the electric locomotive for the steam direct was out of the question, but that there were certain well-defined conditions within the bounds of which such substitution was even at the present time feasible and economical.

In an article appearing in the *Railroad Gazette*, Mr. Arthur T. Woods discusses the same problem from the steam railway engineers' standpoint and, we are glad to note, arrives, in the main, at the same conclusions as Mr. Sprague, thus emphasizing our contention that competent electrical engineers are fully aware of the nature of the electric railway problem, and that the profession as a class ought not to be held responsible for the loose statements of individual cranks and visionaries.

COMING DEVELOPMENT OF ELECTRIC RAILWAYS.—IV.

(*Concluded.*)

BY FRANK J. SPRAGUE.

Among the roads which are ripe for the electrical engineer, and on which, in the near future, I hope he will demonstrate he has a most legitimate claim, are the New York Elevated and Chicago Elevated, the handling of the trains on the New York Central and Harlem roads below the Harlem River, the long-talked-of rapid transit road of New York, the Metropolitan underground road of London, the proposed tunnel roads in London, Paris and Berlin, and, coming more immediately home, suburban service such as that of the Illinois Central Railroad—a most ideal track for the electrical engineer; and last, and as it will prove, one of the most important, the operation of terminal and warehouse systems for the interchange of freight on the lines entering a city situated like Chicago.

Taking this last, we have here a definite problem, now performed in a more or less satisfactory way by steam service. It is a problem large enough of itself. It has little connection with electric trunk-line service, and the present impracticability of the latter has little bearing upon the thorough practicability of the former. Eighteen hundred, or more, switch engines, many of them on duty twenty-four hours a day, a large portion of the time standing idle, puff their foulness into your overburdened atmosphere, because from 80 to 90 per cent. of all the freight that comes into the depots of this city ought never come inside its limits, and would not, were there a practical way provided to distribute it from one railroad to another outside the city limits. It has been suggested, and it seems to me a most feasible plan, that there shall be established a vast system for interchanging freight on the various railroads by a great six-track crossing belt road, which shall form a common zone of transfer either by itself or in combination with freight warehouses or storage yards. Undoubtedly there are many difficulties in the way, but from an electrical standpoint there is absolutely no question but that such a system of belt line is practicable.

With such unsolved problems, such abundant fields, I deem it unnecessary now to attempt to build electric locomotives to pull trains of great weight 100 miles an hour, or to develop a system of conductors for trunk-line service which is not possible for yard duty, or to consider a central station or track equipment for a duty never required. This problem is in a measure an experimental one, which, being carried to a certain measure of success, will clearly point the way for future development and outline its limits.

I may be pardoned, perhaps, if I take radical views in some matters of railroad practice. I have fortunately, or otherwise, been thrown into direct touch with all the larger work which is to be done in this country during the coming year, and it gives me pleasure to announce, what many of you know from the current news of the day, that there will probably be in operation in the United States, within twelve months, not less than five locomotives varying from 700 to 1,200 h.p. and from 45 to 80 tons in weight. The character of the work done will vary. In that work which I am most concerned with from a personal standpoint, a 700 electric locomotive will be built for experimental work, and to attempt to solve, as far as may be, the various problems which are involved in railroad practice in Chicago. If my judgment is followed, there will be an experimental section of track in the form of a loop about thirteen miles long, with eighteen miles of rail, and with every variety of single and double track construction and simple and compound crossings and switches.

On this I hope to see erected such varieties of overhead construction as may be found best to meet the various kinds of service, and where the railroad problems on track jointly operated by steam and electricity can be developed in the most satisfactory manner. On this track there will be not only this locomotive but also one of equal rated capacity supplied by one of the larger manufacturing companies.

The duty demanded of these machines will be severe. They will be required to haul a train of not less than 450 tons at 30 miles an hour up a grade of 26 feet to a mile. They will probably be required to develop their full rate of capacity at all speeds between 30 and 60 miles per hour, and if there is sufficient track-room they will be driven at speeds of at least 75 and perhaps 100 miles per hour for short distances. The potentials used will be nearly double that at present obtained in street railway practice.

A still larger problem so far as power goes, although not in the variety of conditions which will have to be met, will be that recently taken for the operation of the belt line tunnel now being constructed in Baltimore to avoid the necessity of boat transfer at Locust Point. The duty of the motor here will be to propel the train with engines coupled on but not in operation through a tunnel about 6,000 feet long. The conditions require the motors which will weigh about 80 tons, and have a capacity of about 1,200 h. p. to propel a 1,200-ton freight train up a grade of 42 feet to the mile at a speed of 15 miles per hour. Passenger trains of of 450 tons weight must be regularly started from rest twice in the tunnel on this grade, and in an emergency the motors must start the freight train. The draw-bar pull under regular duty, and when not starting, may be as high as 32,000 pounds.

Perhaps the traffic from New York to Philadelphia affords as good an example as any of what may be done on regular passenger service, provided the track is clear enough. For this, I some three years ago, and again in *The Forum* of September, 1891, outlined an electric express service with a method of supply through a rod carried above the car and a return circuit through the rails and earth. The current was to be supplied from one or more central stations equipped with high-class triple-expansion engines driving multipolar dynamos directly coupled. What the electrical engineer and the railroad men as well needs to know is whether the electromotice force required on the line and the number of stations necessary would be prohibitory.

No attempt was made for an excessive speed, but I confined myself to the average speed of a mile a minute for a distance of 90 miles, and considered a through service only. I assume a total weight of copper of only about two-thirds that which exists on the long-distance telephone line between New York and Boston. The trains were to be two-car units leaving every ten minutes.

I found with these conditions the stations and potentials would be about as shown in the following table:

Stations.	Miles apart.	Potential.	
		Two-wire.	Three-wire.
1	—	3,600	1,800
2	45	1,800	900
3	30	1,200	600
4	22½	900	450

If the three-wire system is used, that is, the rails as a compensating conductor between two trolley roads, then with only two stations 45 miles apart it is seen that the potential is less than 1,000 volts, and this we undoubtedly can handle.

I am not prepared to say that we may not use even a higher pressure, because I believe whatever is demanded in the interests of economy, all things being considered, will be used; but if we can reduce the potential to perfectly safe and reasonable limits by multiplying the number of stations, then those stations should be increased so long as the increase does not seriously affect the general expense of working. On a service of this character, where I have made the conditions, distributed work and the dispatching of units at brief intervals—which conditions, I repeat, are absolutely necessary if we are to consider long-distance transportation by electricity—such increase of stations as is advisable will not increase the cost of central station operation.

Such is the work before you, a work well meriting your best efforts, yet it is well to temper your enthusiasm with prudence. Limit your attempts to the solution of those problems which will prove of practical benefit. Do not chase rainbows. They are beautiful and poetic, but they have small place in the world's economies. Remember that neither sentiment nor ignorance, but lessened costs of operation for equivalent duty and increased returns on invested capital, are winning cards.

All this is said in no spirit of discouragement, for I yield to no man in my confidence in the future of electric traction. No new field is so rich, none more pregnant with great possibilities; but the growth of the work will be more expeditious and healthy if we separate the visionary from the real, the impracticable from the practicable.

A DYNAMO INDICATOR, OR INSTANTANEOUS CURVE-WRITING VOLTMETER.[1]

BY PROF. GEORGE S. MOLER.

IN connection with the work in dynamo and motor testing in the physical laboratory of Cornell University, it was found desirable that some method should be devised which would enable the student experimenting to very quickly explore the field of a machine, so that he could study some of the changes which might take place even in a few seconds. The double-brush method of Dr. S. P. Thompson, and the single-brush method of Mr. W. M. Mordey, are in use and give excellent results, but either of these methods requires a few minutes at the very shortest to obtain the data for a single curve.

To attempt to meet this want the writer devised the instrument which is the subject of this paper. It is intended to be used in tracing those curves which show the changes in potential of the two ends of a single coil of the armature, and also those showing the changes between one brush and one of the commutator bars, as the armature revolves. The instrument consists in the main of a very rapidly vibrating needle of a voltmeter, and a smoked cylinder against which the pointer is made to press at the required moment. The curve is traced during a single revolution of the armature and is then easily transferred to paper, and is thus placed in a permanent form to be studied at leisure. The voltmeter, which is inclosed in the body of the instrument, is of the permanent magnet form. The needle is of soft iron, and is very short, and held at zero by being placed between the poles of a powerful steel magnet. The pointer is made of aluminum and is quite short. It is shaped so as to be as light as possible, and so that the air cannot offer much resistance to its motion. The cylinder is of metal and very smoothly finished, so that it will offer little resistance to the movement of the pointer. It is mounted upon a short shaft and is arranged so that it can be slid to several different positions; a spring dropping into notches holds it at each place. The stationary pivot at A, Fig. 1, is made with a spring so that the cylinder can be quickly removed for smoking or for transferring the curves. This short shaft is connected with the driving shaft of the instrument by projecting pins at B, so that it will always maintain the same relative position with the pin at C. The pin C is attached to a sliding sleeve which is pushed toward the point of the shaft by a spring. A hole or a pin in the end of the armature shaft is to engage with the pin C, so that the cylinder will always have the same relative position with the armature. To operate the instrument two insulated wire hoops or bands are to be wound around some convenient part of the shaft or commutator, and one is to be connected to one commutator bar and the other to one of the adjacent ones. Small brushes are to be made to press upon these bands, and they are to be connected to the binding screws at D. The cylinder is then lightly smoked by removing it and revolving it over a candle or gas flame; then it is placed in position. The sleeve carrying the pin C is pulled back and latched in the notch E. Then the point is pressed into the centre hole in the end of the armature shaft; this will put the drum in motion; then by letting the projecting knob strike the finger the sleeve will be unlatched, and will spring forward and engage with the pin in the end of the armature shaft. Then pressing the button F closes the circuit, and pressing G brings the pointer against the drum. H is a reversing switch. The base line of the curve is drawn by pressing G only. Another form of curve will be obtained if one of the terminals of the indicator is attached to one of the permanent brushes of the dynamo, and the other to one of the brushes pressing upon the band connecting with one of the commutator strips. Also a temporary exploring coil may be wound upon the armature, and its terminals may be connected to the indicator.

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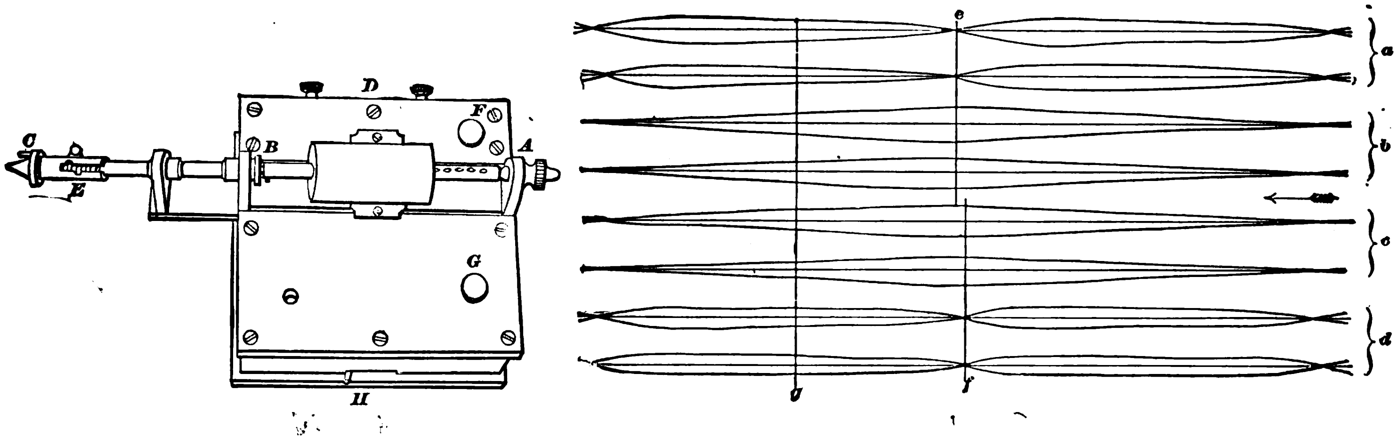
[1] A paper read at the general meeting of the American Institute of Electrical Engineers, Chicago, June 6, 7, and 8, 1892.

The voltmeter of the indicator is necessarily one of low potential, so that the changes in a single coil will produce a suitable deflection. For greater changes of potential a resistance must be used in series with it. The curves are transferred from the smoked cylinder by dampening a sheet of paper and then rolling the cylinder over it. Three distinct copies have in this way been made from one set of curves. One of these instruments has been built and has been tested in various ways and is found to give very satisfactory results. The rate of vibration of the needle was determined while the pointer was in contact with the revolving drum and was obtained as follows: A current was applied so as to produce a deflection, then while the drum was revolving at over a thousand revolutions per minute the needle was brought in contact with it and the circuit was then broken, making a wavy line extending part way around the drum before it died out. The average rate of oscillation as determined from over 40 measurements was 103 per second, and the damping effect was so great that in .04 of a second the needle was brought to rest. It was also observed that the deflection was not changed by bringing the pointer in contact with the revolving drum.

One of the desirable features of the indicator is the rapidity with which the curves can be made. The cylinder full of curves, 18 in all, with their base lines, was made in 78 seconds, so it is seen we can explore the field many times while a dynamo is charging up just after being started, or while any great change in load is being made.

In Fig, 2 are shown some of the curves produced by exploring the field of a 20-ampere shunt-wound dynamo of the consequent pole type The dynamo was driven at a speed of 1,075 revolutions per minute, and had an automatic regulator, which held it at 115 volts, with slight variations. The curves *a* and *b* were made while 20 amperes were flowing in the main line, and *c* and *d* while the outside circuit was broken. The curves *a* and *d* show the changes in potential of the two ends of a single coil. The line *g* shows the position of the centre of the pole-piece, and the arrow the forward direction of the curves. The double curves upon each base line, were made by reversing the terminals by means of the switch H. The line *e* is the position of the neutral point when 20 amperes were flowing, and *f* its position when the line is open. The difference in shape of the curves shown at *a* and those at *d* is very marked. The curves *b* and *c* were made by connecting one terminal to one of the dynamo brushes, and the other to one of the brushes connected to one end of a coil. These also show the change of the neutral point, and a change in shape for open and closed circuit.



Figs. 1 and 2.—Moler Instantaneous Curve Writing Voltmeter.

The instrument is calibrated by comparison with a standard voltmeter. For each reading on the voltmeter a line is drawn around the drum. When the pointer is not in contact with the drum some of the effects of inertia can be noticed, but when contact is made they seem to almost disappear, and corrections may be applied to compensate for the lag on that account.

To test the reliability of the instrument one of the 20-ampere curves for half a revolution and similar to *a*, Fig. 2, was taken at random, and the data taken by two students, over which to obtain they worked at least an hour, and had to contend with fluctuating speed and voltage. These two curves were drawn to the same scale and are shown in Fig. 3, the heavier and most fluctuating line being by the experiment. The agreement is about all that can be expected, so it seems that the instrument is capable of giving reliable results.

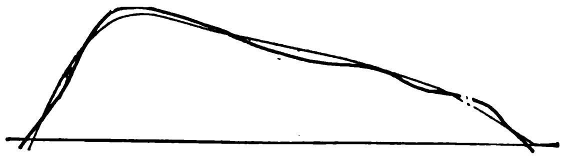


Fig. 3.

CRANFORD AND SOUTH SIDE TELEGRAPH UNION.

This society, organized last year, has now seven stations and a line 1½ miles long in the village of Cranford, N. J. The president is S. J. Cox, Jr., and F. W. Ells is secretary and treasurer. The line is governed by an executive committee composed of a representative from each station elected annually by the union. The president is chairman of this committee, which has power to impose fines, levy assessments, purchase supplies and transact all the other business connected with the line.

It has been proposed to consolidate the union with the Cranford Telegraph Association, a similar organization in the same town, which would give it a total of 3½ miles and 20 stations, taking in the entire village. The two associations have a complete code of fire, burglar and emergency signals, and, though not yet consolidated, are connected and act together for the common good.

ELEVENTH ANNUAL MEETING OF THE RAILWAY TELEGRAPH SUPERINTENDENTS' ASSOCIATION, AT DENVER, COL., JUNE 15 AND 16, 1892.

The 11th annual meeting was held at the Hotel Albany, Denver, Col., June 15 and 16. The following members and guests were in attendance:

C. S. Jones, Ill. Central, Chicago; A. R. Swift, C., R. I. & P. R. R., Chicago; C. Selden, B. & O. R. R., Baltimore; O. C. Greene, No. Pac. R. R., St. Paul; C. M. Dugan, Ill. Central R. R., Jackson, Tenn.; P. W. Drew, Wis. Central R. R., Chicago; M. Magiff, Central Vt., St. Albans, Vt.; H. C. Hope, C., St. P. M. & O., St. Paul; G. L. Lang, N. Y. and N. E. R. R., Boston; M. B. Leonard, Ches. & Ohio R. R., Richmond, Va.; C. A. Darlton, R. & D. R. R., Atlanta, Ga.; J. L. Orbison, C. H. & D., Cincinnati, O.; J. C. Ford, C., St. P. and K. C., St. Paul; G. R. Kimball, B. & O., Newark, O.; G. T. Williams, N. Y. C. and St. L., Cleveland, O.; L. B. Folley, D. L. & W., New York; J. T. Gibbons, D. L. & W., New York; K McKenzie, M. & O., Jackson, Tenn.; H. C. Reed. M. L. S. and W., Milwaukee; J. B. Stewart, West Shore, New York; W. W. Jackson, N. Y. and N. E. R. R., Providence, R. I.; R. J. M. Danley, C. H. & S., Columbus, O.; W. B. Ward, B. C. R. & N., Cedar Rapids, Ia.; W. D. Vincent, B. & O., Pittsburgh; S. K. Bullard, M. K. & T., Sedalia, Mo.; U. J. Fry, C. M. & St. P., Milwaukee, Wis.; W. J. Holton, C. & W. I., Chicago; D. H. Caldwell, N. Y. C. & St. L., Fort Wayne; G. C. Kinsman, Wabash R. R.; Decatur, Ill.; H. C. Sprague, K. C., Ft. S. and M., Kansas City; C. H. Corty, U. P. R. R., Omaha, Neb.; C. G. Sholes, A., T. & S. F. R. R., Topeka, Kan.; A. R. Lingafelt, C. R. I. & P. R. R., Topeka, Kan.; W. P. McFarlane, F. E. & M. V., Omaha, Neb.; C. S. Rhoads, C. C. C. and St. L., Indianapolis, Ind.; F. M. Duncan, D. & R. G., Denver, Col.; W. W. Ryder, C. B. & Q. R. R., Chicago; Geo. B. McCoy, Ill. Central, Memphis, Tenn.: J. J. Dickey, Supt. W. U. Tel. Co., Omaha, Neb.; R. B. Gemmell, A. T. & S. F., Topeka, Kan.; E. R. Adams, P. & R., Reading, Pa.; J. J. Burns, D. & R. G., Pueblo, Col.; E. W. Hammond, Missouri Pacific, St. Louis, Mo.; E. E. Rittenhouse, Col. Midland, Pueblo, Col.; J. W. Lattig, Easton, Pa.; S. S. Bogart, New York; W. S. Logue, New York; H. F. Houghton, Decatur. Ill.; J. B. Shaw, Jamestown, N. Y.; Ralph W. Pope, New York; T. D. Lockwood, Boston; T. J. Smith, New York; H. R. Wilson, Chicago, Ill.; D. C. Matheson, Flint, Mich.; T. R. Taltavall, New York; G. W. Crook, Valparaiso, Ind.; A. P. Willoughby, Chicago; C. P. Mackie, New York; M. C. Gilham, Kansas City.

The first session was called to order at 10:30 a. m. June 15, by President C. S. Jones.

The following officers were elected to serve for the ensuing year: President, L. B. Korty, Omaha, Neb.; vice-president, U. J. Fry, Milwaukee, Wis.; secretary and treasurer, P. W. Drew, Chicago, Ill. It was voted that the next meeting be held at Milwaukee, Wis., June 20, 1893.

Mr. S. S. Bogart read a paper on batteries in which he called attention to the adaptability of the Edison-Lalande battery for electric railway signal work. Its internal resistance was but $\frac{1}{10}$ of an ohm, it was perfectly constant, would not sulphate and was not affected by low temperature. He believed the time had arrived when they should discard the sulphate of copper battery. He was using it for block signals in preference to all others. He used four cells in series, on closed circuit with a resistance of 10 ohms. There is tapped out of it a sounder, alarm bell and annunciator, the last two on the same cell.

At the close of Mr. Bogart's paper the meeting was visited by Governor Routt of Colorado, who delivered an address of welcome which was responded to by President Jones.

The afternoon session on Tuesday was called to order at 2:45 p. m. A paper by Mr. Edison on Insulation was read by Mr. M. B. Leonard.

Mr. T. D. Lockwood stated that he was pleased to note the statement that pure water was not a conductor, although in practice we could neither get pure water nor keep it pure if obtained. In New York City it was very difficult to maintain insulation on account of the steam pipes, and some cables after being laid were found weak in spots. It was found that very small particles of water were moved along by the heat. Condensation accumulated the moisture in one spot and made a leak. In reply to an inquiry by Mr. Gemmell, as to the practical use of oil insulators, Mr. T. J. Smith said that they were now made in this country but there had been little demand for them. They had however been highly spoken of by those who had used them.

In the absence of the author Mr. C. A. Darlton read a paper by Prof. W. A. Gardner on "The Government Time System in its Relations, Practically to Railroad Matters."

Mr. Lockwood then gave a blackboard talk on "The Galvanometer and its Uses" which was devoted to a popular explanation of the handling of that instrument especially for telegraph work.

At the opening of the morning session on Wednesday, Mr. Chas. Selden read a paper upon "Electricity in its Relation to Transportation." [1]

Mr. Lockwood said that the railroad community at large owed a great debt to the Baltimore & Ohio R. R. Co., for its advance step in experimenting with the electric motor for use in tunnels, although it was not really an experiment. He did not look for the immediate application of electricity to trunk lines, but electricity was no exception to the rule that tall oaks from little acorns grow. He took the plan of Dr. Adams with a grain of salt in his proposed electrical air line between St. Louis and Chicago, yet he believed that for suburban traffic electricity would yet be found to have advantages over steam. Mr. Selden said that the actual available horse power of the locomotive was but 30 per cent. of the theoretical and under unfavorable conditions fell to 10 per cent. and that it was impossible to get as good results from a locomotive as from a stationary engine.

Mr. J. B. Stewart then read a paper entitled, "The Block Signals of the Present and What is Required for the Future." [4]

Mr. Selden said that in Maryland the law required that either a flagman or signal must be placed at each crossing. He had made arrangements to substitute bells for flagmen. They now paid $18,700 per year for service that could be performed at a cost of $2,000 by the use of bells. The worst accidents they had had, occurred when the watchman was asleep. In Philadelphia they had 20 crossings guarded by bells, and the only accident they had had was the killing of a horse. In this case the owner wished to have him killed as he needed a new horse, and he got one.

Mr. Hammond stated that they had had similar accidents on the Missouri Pacific, but had not been able to prove that the bell was ringing when they occurred.

At the afternoon session on Wednesday, the following committees were apointed: Messrs. Selden, Greene and Gemmell to revise the constitution; Messrs. Swift, Ford and Sholes, to prepare a new form of service card; Messrs. Reed, Fry and Ford, on arrangements for the next meeting; Messrs. J. B. Stewart, Gemmell and Adams on Topics, and Messrs. Selden, Leonard and Darlton on acknowledgment for courtesies extended by the C., R. I. & P., the Denver & Rio Grande, the Union Pacific, the Atchison, Topeka & Santa Fé, the C. B. & Q., the Manitou & Pike's Peak Railroad Companies, the Colorado Telephone Co., the Commercial and Athletic Clubs, Wyckoff, Seamans & Benedict, and many others.

The formal business of the meeting being finished, the retiring President Jones called President-elect Korty to the chair, and in transferring the gavel, said that he desired to express his satisfaction at the most splendid success they had achieved at this meeting, which was of course due to the large attendance of members and their enthusiasm. President Korty in reply, said that he was deeply sensible of his inability to fill the position. but would do his best. The meeting then adjourned to June 20, 1893.

Friday was devoted to a trip over the Clear Creek Division of the Union Pacific R. R., which embraces the famous Georgetown loop. The Mendota silver mine was also visited. Saturday the members were the guests of the Denver and Rio Grande Co. and the Manitou & Pike's peak R. R., and were taken over this famous cog-wheel line. Upon their return the Colorado Midland R. R. Co. ran a special through Ute Pass and return for their entertainment, and on Sunday the Denver and Rio Grande gave them a trip through the Royal Gorge to the Hanging Bridge. One of the most interesting events of the trip was the presentation of a solid silver salad bowl, fork and spoon to Mr. and Mrs. Swift in remembrance of the thoughtful preparations for the trip and their watchful attention to all who had the pleasure of enjoying the many courtesies extented to the association during its visit to the Centennial State.

EXHIBITS.

Distance did not interfere with the enterprising exhibitors, who in their efforts to show the merits of their various exhibits added much to the interest and importance of the meeting.

The Leonard train order signal and the Leonard block signal were exhibited by the Electric Secret Service Co. Working models of these signals were shown in combination with the automatic selective apparatus of the Electric Secret Service Co. Other applications of the latter were shown adapted for telegraph, electric light and power service.

A working set of the Edison phonoplex was shown in actual operation, being connected with the line to Cañon City. Current was supplied by the Edison-Lalande battery, various sizes and forms of which were also on exhibition.

The Dulaney self-winding clock operated by two cells of gravity battery attracted much attention, it being in practical use on the C. B. & Q. R. R.

The Gill-Alexander Electric Manufacturing Co. was represented by M. C. Gillham who had arranged a working exhibit of the system of selective apparatus manufactured by that company.

The iron gravity battery manufactured by the Standard Battery Co., 324 Dearborn street, Chicago, was shown by Dr. A. P. Willoughby. In this battery an iron electrode is substituted for the zinc as ordinarily used. A secret compound is used for starting it. The battery is now being tested by various companies.

The "Excessive Current Protector" invented by I. N. Miller of

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[1] See page 15.

Columbus, Ohio, was on exhibition and was explained by Mr. Leonard.

Samples of insulating fibre were shown by the Laminar Fibre Goods Co., of Boston.

FIRST ANNUAL CONVENTION OF THE CANADIAN ELECTRICAL ASSOCIATION, HAMILTON, JUNE 14, 15 AND 16, 1892.

The first annual convention of the Association was opened at the Board of Trade Building, Hamilton, Canada, on the afternoon of June 14. A business meeting of the executive committee was held previously, at which thirty-four new members were admitted.

After the opening of the regular session, President Wright delivered his address, in which he referred to the flourishing condition of the association, whose membership includes representatives of every branch of electrical industry. The object of the organization was to promote the interests of those engaged in electrical pursuits from both a commercial and scientific standpoint. He suggested the appointment of a committee to collect and compile statistical information, such as, for instance, the number of electric lights in use in the different cities and towns of Canada; particulars as to their operation under various conditions, the cost of operation and condition of electric lighting plants operated by municipalities, etc.

The Mayor was introduced and addressed the members, cordially welcoming them to the city.

A resolution of condolence with the family of the late W. C. Palmer, of Toronto, was passed.

Secretary Mortimer then read his report, briefly reviewing the work of the association since its organization and stating its financial condition, which was very satisfactory, there being nearly $400 on hand.

The following officers were elected for the ensuing year: President, J. J. Wright, Toronto; first vice-president, K. J. Dunstan, Toronto; second vice-president, John Carroll, Montreal; secretary-treasurer, C. H. Mortimer, Toronto; executive committee (new members), L. B. MacFarlane, D. A. Starr; (old members) H. O. Fisk, A. B. Smith, W. A. Johnson, D. Thomson, T. H. Wadland, John Yule, S. J. Parker.

Two committees were appointed; one on statistics and the other to revise the by-laws and constitution of the association.

The evening was spent profitably and pleasantly by the members in inspecting the new station of the Hamilton Electric Light and Power Company, whose officers entertained the visitors with a lunch.

At the morning session on Wednesday, the 15th, the first paper was presented by Mr. Hugh Neilson on "Long-Distance Telephony," in which he gave an account of what had been accomplished in this department, and described the equipment and line construction. Canada, he claimed, was the home of the telephone, having more instruments in proportion to its population than any other country.

Mr. D. Thomson next read a paper on "Central Stations," giving details as to the manner in which they should be constructed and arranged, and touching upon the best engines and dynamos to use.

The association was invited by Mr. Larke, representing the Dominion Government, to make an exhibit at the World's Fair, Chicago. The Government, he stated, would pay the cost of transportation and take care of exhibits in Chicago, and no duty would be charged by the United States Government.

Mr. H. O. Fisk then read a paper on "Carbons," treating the subject thoroughly and going into intricate details of manufacture, illustrated by photographs. The president remarked that this paper was one of special value, and a vote of thanks was given Mr. Fisk.

Mr. D. Thomson moved a resolution fixing the following standard of current in amperes: *Resolved*, "That it is the unanimous opinion of this association that when the carbons in an arc lamp are at the proper distance apart to give their maximum amount of light, without either flaming or frying, that the strength of current for a 2,000 (nominal) c. p. arc shall be not less than nine and a half amperes; for a 1,200 (nominal) c. p. arc it shall be not less than eight amperes; for a 1,000 (nominal) c. p. arc it shall be not less than six amperes; and for an 800 (nominal) c. p. arc it shall be not less than four amperes."

This resolution was seconded by Mr. D. A. Starr and considerable discussion followed, many members saying that it would be inadvisable to pass the resolution, in view of the threatened legislation of the Government fixing a standard. An amendment, postponing the discussion of the question till the next annual meeting, was carried.

Before assembling for the afternoon session the members visited the new exchange of the Bell Telephone Co., one of the handsomest and best equipped on the continent.

On resuming business in the afternoon, it was decided to hold the next meeting at Toronto in January.

The president read an interesting paper prepared by Mr. S. J. Parker on the "Financial Aspects of Electric Lighting in Canada," which led to considerable discussion amongst the members.

President Wright next read his own paper on "Steam and Electric Power," on which subject he gave much valuable information and many useful points upon the production and distribution of electricity.

A paper on "Multiple Switchboards" was presented by Mr. J. A. Baylis, of the Bell Telephone Co., Toronto.

After that Mr. W. A. Johnson read a paper on the "Possibilities of Electric Railroading," in which he described what would probably be the future development of electric railways. The trolley, he considered, would continue in general use, with the possible exception of short lines in large cities, where cost is sometimes a secondary matter.

In the evening there was an excursion to Burlington Beach and an informal banquet there at the Ocean House. A pleasant feature was the presentation of a handsome gold watch to President Wright, as an evidence of appreciation by the members of his services in the interests of the association.

At the closing session, Thursday morning, Mr. A. B. Smith, the inspector of the Canadian Board of Fire Underwriters, read a paper on "Safe Wiring." After this, votes of thanks were passed to the Bell Telephone Co., the Hamilton Electric Light and Power Co., the Great Northwestern Telegraph Co., and the Board of Trade, for invitations and facilities extended the association. Votes of thanks were also given to Mr. C. H. Mortimer, the popular secretary, and the press.

The association pledged itself to do everything in its power to secure a large and thoroughly satisfactory exhibit of Canadian manufactures of electrical apparatus at the World's Fair, Chicago.

The number of members in attendance was about seventy-five. After adjournment, the members were taken for a drive around the city and mountain.

ELECTRICITY AND ITS RELATION TO TRANSPORTATION.[1]

BY CHAS. SELDEN.

THE author began by giving a short résumé of the progress of electricity, beginning with the telegraph of Morse up to the most modern applications of electricity as a lighting and motive power.

Passing to the subject of the application of electricity as a substitute for the steam locomotive, the author remarked:

Eminent motive power people have told me that experience shows that, under the best conditions, the locomotive can only be utilized to the extent of 25 per cent. of its power, and 15 per cent. under unfavorable conditions which are met daily. There are several factors that bring this about; partial consumption of fuel under high speeds is one, loss of fuel through exhaust is another, lack of traction is another and so on.

The electric motor has practically dealt exclusively, up to this writing, with the carrying of passengers. There are a few isolated cases in which a freight car or two have been utilized, and records show that in one instance a single car in one year carried 10,460 tons, but unfortunately the records do not show the mileage made by the car, nor its earnings, and hence we cannot reduce the figures to tons carried per mile and earnings. Another difference in the method of accounting is that the figures are based upon the earning and expense per car mile, instead of the ordinary method employed by steam railroads. I have selected as a fair comparison, a steam road that pays a dividend and upon which the earnings from passenger service exceeded the expenses about 25 per cent., taxing the car mileage and reducing it to mile per car, likewise showing earnings per car mile and expenses per car mile. In arriving at my figures some of them were necessarily arbitrary, but in such cases, the percentages, I think, may be considered fair.

The charges to passenger service amount to 26 and a fraction per cent. of the entire operating expense. The cars in daily service were 618, and the mileage made during the year 36,672,550 miles, or for each car 59,340 miles. The earnings (including mail and express—a source of revenue the electric roads do not enjoy) were $7,078,147.64, or per car $11,453.31, or per car mile 19.30 cents.

The expenses, classified as above, were $4,552,992.84, or per car, $7,367.30, or per car mile 12.41 cents, a net earning per car mile of 6.89 cents. The mail and express included in the above earned over $1,100,000, or in the neighborhood of one-seventh of the whole.

From an average of a number of electric roads, good, bad and indifferent, I have found the earnings to be 30.31 cents per car mile, and expenses 11.10 cents per car mile, leaving a net of 19.21 cents per mile, or a net gain over the steam road of 12.32 cents per mile.

These figures seem to show that the average of electric roads earned much more per car mile than the steam roads, and at an expense of only 1.81 cents per car mile less than the steam road. This slight difference in expense looks somewhat discouraging, but it must be borne in mind that the electric road figures are an average of a number of roads compared against a dividend earner and a net passenger traffic. There are electric roads operating for 7.8 cents per car mile and earning 24 cents per car mile, a difference in their favor in both earnings and expenses that catches the eye at once. Again, the steam road enjoys cheap fuel as against the electric road's high priced fuel and water. A crew of five men to five-car steam trains, as against ten men to five electric cars, and a proportion of taxation is charged against electric and not against steam in the figures given, and there are other matters entering into the expenses of operation that do not enter into the maintenance of steam roads, such as street paving, per cent. of gross receipts, park tax, etc. Hence, when we analyze we have no reason to complain, and I think we can safely assert the economy of electric motive power over steam, at least in certain localities and under certain conditions, and I believe in nearly, if not all.

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[1] Abstract of a paper read before the Association of Railway Telegraph Superintendents, Denver, Col., June 15, 1892.

Let me ask the general managers whether there is not some piece of road that is now operated at a loss that could be operated at a profit by electricity? You have track, you have coal, you have power houses. Is there not some such territory on your own road?

Take suburban roads, or suburban points upon a through line, do you not strive and spend money to build up the locations? Do you not sometimes for years maintain a non-paying territory clearly on hope and speculation as to the future? Do you ever satisfy the commuter? Does not a percentage want the 11 o'clock train made 12 o'clock, and *vice versa*, and perhaps both? You meet this by saying you are doing the best you can and losing money at that? Now, then, how much quicker could you build up such a territory by more frequent and less expensive trains, and carry freight cars too, one by one, or two or three, and thus supply your local traffic; or if needs be, steam must haul freight, let it be done on the same track; they will work right along together. But, say you, the question of "speed comes in." So it does, yet I think you will find that the suburban public would rather have 24 trains a day at 20 miles an hour than 12 trains at 40 miles an hour, and I do not intend here to beg the question of speed. When it comes to speed, *per se*, rotary motion is undeniably capable of it with less strain and wear and tear than the reciprocating.

The author then described the work now being undertaken by the Baltimore and Ohio R.R. in the substitution of electric locomotives for the steam in the hauling of cars through the Baltimore Belt Tunnel, an account of which has already appeared in our columns. He also described the electric street railway system of Mr. Elias E. Ries which operates by induction between a series of stationary converters below the surface of the street, and a converter feeding current to alternating motor on the car, thus avoiding all conduits, trolley wires, etc. A working model of this system was shown.

Letters to the Editor.

RELATIVE PROPORTIONS IN RAILWAY POWER PLANTS.

I AM glad to note the discussion provoked on the subject of relative proportions in railway power plants.[1] My object in writing on this topic is fully as much to learn as to teach, and I deem there is no better method of averaging up the best practice than through the interchange of experience in a journal of the character of THE ELECTRICAL ENGINEER. And yet the term "average of practice" is a bad one, inasmuch as there can be no general average, but each engineer must determine the best all-around results for himself to be obtained with the types of apparatus he works with, and the varying conditions to be met.

I see by the comments already made that I ought to have stated at the outset that my articles are directed mainly to the discussion of *small* power stations. If this fact is borne in mind it will help considerably to understand the drift of my statements. The big stations are backed by abundance of capital, and usually are carefully worked out on paper to start with. The little country stations are more apt to pursue an alleged economy in respect to their engineering, and suffer in consequence. To my mind the time has fully come when the little station should receive the special care and nursing to which the weak infant is always entitled. Hence my own personal interest has been almost wholly aroused in this direction, and my articles will please be interpreted in the light of this fact.

I note too, that both of your correspondents have anticipated the points which I had scheduled for future articles in the series. This of course cannot be helped, but from this fact I shall take the liberty to reply less fully at the present time, since the same ground will be gone over more sequentially in future papers.

Mr. Hewitt[2] is accurate in his statement that I am more familiar with the steam engine than with the dynamo, and I am almost disposed to accept this as a professional compliment. I was born to engines, achieved boilers, but had dynamos thrust upon me; and so I propose to fight shy of the dynamo side of the question so far as practicable, and turn the responsibility of that department over to the electrical engineer to whom it belongs. Nevertheless, it can hardly be supposed that I am ignorant of the fact that heat in a generator is a most serious difficulty, (in fact, I intended that my expression should convey precisely that idea,) or again, that the E. M. F. was impaired by overload. But these articles do not propose to consider the effect upon the car service, but will confine themselves strictly to the generating plant and the inter-relation of its three elements on the assumption that the right quantities are determined at the start. On that portion comprised within the steam plant proper, I feel that I may speak with some authority, even in its relation to the generators themselves.

Mr. Hewitt is, I think, quite right in his statement, that on plants of 25 cars and over, the average load is in the neighborhood of two-thirds of the maximum. I am not worrying myself much about roads even of this capacity, and Mr. Book[3] has hit the conditions exactly, when he states that the larger the station the simpler is the engineering problem. This I believe to be strikingly true, notwithstanding a hasty supposition to the contrary. I find it imposes a much greater tax upon my judgment to lay out the little 10-car plants, than it does stations of three or four times this capacity. Fluctuations of the widest and most unexpected nature are to be contended with, and how to get out of these conditions a reasonable performance as to fuel duty, and what proportion of units to adopt in the attempt, is a problem of no small complexity.

The fact that the doctors disagree on this subject is beautifully illustrated by your two correspondents. Mr. Hewitt would proportion a station about as follows:

Dynamo, 100 E. H. P. rated.
Engine, 92 E. H. P. rated.
Boiler, 86 E. H. P. rated.

Mr. Book on the other hand, would follow out a proportion, thus:

Dynamo, 100 E. H. P. rated,
Engine, 50 E. H. P. rated,
Boiler, 76 E. H. P. rated.

Evidently there is a lack of uniformity of experience here, and I may venture to disagree with both parties and tabulate my own practice about as follows, referring, be it observed always, to the small stations:

Dynamo, 100 E. H. P. rated,
Engine, 120 E. H. P. rated,
Boiler, 60 E. H. P. rated.

Moreover, I have chewed the string long enough to prove that this pudding is entirely wholesome.

I wish to say right here that some of my clients, who are practical operators of roads, have disagreed with me from the first on the policy of having an excess of power in the engine. They admit the desirability of being able to pull over the high spots without losing speed, but they also claim that it is a positive detriment to have an excess of power which will burn out everything in case of a short-circuit, and they would prefer to have the engine give warning of its excessive load by its inability to carry it at speed. It seems to me that I cannot altogether agree with this view, from the fact, that it is to a certain extent a damage to the engine to slow it down, and take off the compression which is the main dependence for easing its running qualities. I feel more disposed to depend on the fuses or circuit breakers, and let the engine stand right up to its work.

Since my first article was originally written some months ago, however, I confess to having become fairly convinced that a smaller horse power, that is, *rated* horse power, is admissible than I had originally ventured to adopt. This is not due to the line of reasoning alluded to above, but depends upon the ascertained fact that a compound engine, after all, has fully as large a margin of power over its rating as a non-compound. Mr. Book does not so regard the case and charges me with using excessive rated engine power on account of scant surplus in the engine itself. I beg to say that the excess of engine power is not for this reason at all, but rests purely upon the assumed comparatively rigid capacity of the engine as compared with the greater range of the generator. I find lately, however, no difficulty in getting engine performance, such as shown by the accompanying card without any diminution of speed, and Mr. Book will recognize that there is a margin here fully equal to the severe demands of the generator, and fully equal to the performance of any non-compound engine in this respect. If the card in question were from an engine

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[1] See THE ELECTRICAL ENGINEER, April 27, "Points on Railway Power Stations," by Wm. Lee Church.

[2] THE ELECTRICAL ENGINEER, June 1, p. 548.

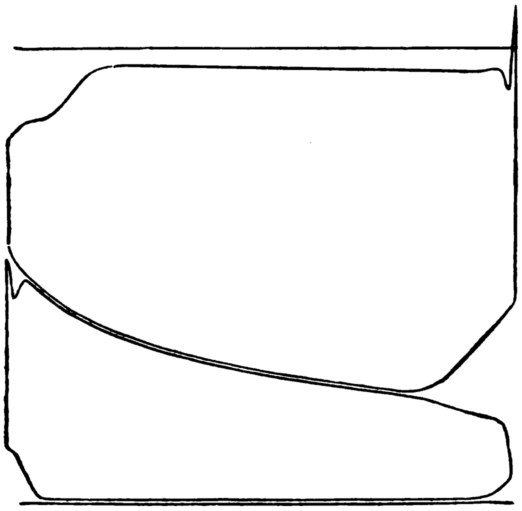
[3] THE ELECTRICAL ENGINEER, June 1, p. 552.

rating at 100 h. p., the load indicated would represent 135 h. p., and would give all the margin that the generator could be safely warranted to submit to. I would therefore repeat, that the tendency of my late experience is to come down on the size of the engine under certain circumstances, and let a common proportion be:

Dynamo, 100 E. H. P. rated
Engine, 100 E. H. P. rated,
Boiler, 60 E. H. P. rated.

This brings me directly up to the boiler question, on which I feel my position to be absolutely sound, at least within the lines of my own practice. Your correspondents evidently mistake the sources of my belief, and judge that I have arrived at the proportions of boiler power from some theoretical deduction based upon the average of the fluctuation of load. This is as far as possible from being the case, as any such deduction would be very dangerous, from the fact already pointed out in my second article, appearing in your last issue, that the average consumption of steam under fluctuating loads is a very different thing from the consumption of steam due to the average of the fluctuating loads. As a matter of fact, we arrived at this conclusion wholly unexpectedly to ourselves and along a very practical line of experience.

We had occasion to build a station in which the power was two compound non-condensing engines, rating at 100 h. p. each, and the boiler plant, not furnished by us, was four 60 h. p. horizontal return tubular boilers, one of which was intended as a relay. The operation of this plant speedily developed the fact that two of these boilers would furnish steam for the full capacity of the station under the heavy service, and, further, that the station could advantageously be run with a single boiler. In fact, this station is so run a considerable portion of the time. This was a striking instance and led to more careful investigation, which soon developed the proper explanation. It will be seen, therefore, that the fact was first observed, and the reasons subsequently worked out, rather than the contrary supposition.



It seems to me that it should not be difficult to understand that the boiler is taxed only to care for the average of the load, and has nothing to do with the maximum loads directly as such. The maximum load may be very far above the nominal capacity of the boiler, but this maximum will last only for brief intervals, and will be followed by comparatively extended periods of light load, or no load at all. During these periods the boiler is storing heat and pressure, and is prepared to let it loose in enormous quantities to meet the spasmodic demand. The case is precisely that of rolling-mills and saw-mills, and I confess that I am a little ashamed that we had not foreseen the whole thing before encountering it.

Mr. Book must not think that I am referring to any remarkably fine boiler at all. We have used almost every variety of boiler, and find the practice holds good. In fact, I do not see that the type of boiler has much to do with it anyway so long as its actual evaporative capacity is known. The boiler is only chargeable with making a certain number of pounds of steam in a given time; what that boiler can do in the way of developing horse power, then depends upon the intrinsic economy of the engine that takes steam from it. The real misunderstanding in Mr. Book's mind arises from the fact that his experience is doubtless based upon the usual performance of compound non-condensing engines, which will fluctuate all the way from 25 lbs. of water per horse power at full load, to 60 or 70 lbs. at quarter load. Now, since the railway engine is essentially an under-loaded engine—by which I mean that it runs for the greater portion of the *time* at a power far below its rating—it is, therefore, equivalent to saying that its average duty is way up in the air, probably in the neighborhood of 40 lbs. of water per horse power. Hence the "disgust of the stockholder," which a recent correspondent of the ENGINEER feelingly mentions, andhence, also, the obvious fact that the boiler has got to make all this extra steam—ergo, a larger boiler capacity is necessary. Now, to be of any value whatever, under fluctuating loads, a compound non-condensing engine should not exceed, at the outside, 30 lbs. of water per indicated horse power at, say, 20 per cent. of its rating. If the engine, therefore, fluctuates between limits of 24 and 30 lbs., under a railway load, instead of between 25 and 60 or 70 lbs., it does not take long to understand the effect on the boiler capacity.

I wish to give to the above statements all the strength that comes from saying that the foregoing is now our well-settled practice, regarding which there is with us no longer any room for doubt or experiment. We could cite any number of instances. I have already referred to one. In another station in Iowa, two 125 h. p. engines steam easily from two 80 h. p. horizontal boilers. In Michigan, two engines of the same size steam from a single 104 h. p. Babcock & Wilcox, burning wet slabs as fuel. In a station in Maine, two 100 h. p. Manning boilers were put in for two 125 h. p. engines, and as a matter of fact, one of them stands banked most of the time as a relay. In Detroit we are setting three 100 h. p. horizontal boilers to serve three 150 h. p. engines, and expect to keep one of these in reserve at that. In New Haven two 150 h. p. Manning boilers are to serve 480 h. p. of generators, with a third boiler as a reserve; and so on.

Now, I do not wish for a moment to lay down the foregoing statements as rules for anybody else to follow, nor do I even propose them to myself as rules to be invariably followed in every instance. I generally spend the first few days studying out the details of service of each road on its own merits, and I find the characteristics as varied and peculiar as those of human-kind. Each case calls for individual judgment, and my only claim is that this judgment and experience have taken certain well-defined shapes and have established a definite practice on our own part.

All this talk has been about the little ten-car roads. I hope it is clearly understood that the larger the road, the more the three units of generator, engine and boiler come up to the lines of ordinary mill practice in their relative proportions. I expect soon to have some definite results from a station of some 3,000 h. p. capacity, which is about being started, and I may have some experiences to submit in this direction later on.

I have trespassed inexcusably upon your space, and it only remains to say that I cannot see how any one should have inferred from my former article that I was against the idea of spare capacity in the boiler plant, or throughout the whole station, for that matter. It is undeniably true that every station, small or large, should have a complete spare unit in relay at all times. Unfortunately, most of the small stations do not have it, and cannot be persuaded into buying it. When such parties are encountered I am accustomed to insist that there must be spare boiler capacity any how, since when the boiler is laid off it is laid off for at least an entire day. If the road can afford to take its own risk and insure itself against accident, the best place to concentrate that risk is on the engine and dynamo, since there is a better chance for close inspection of this part of the plant, and a much stronger probability of being able to make necessary repairs between stopping and starting hours, Mr. Hewitt to the contrary notwithstanding.

WM. LEE CHURCH.

BOSTON, MASS.

WHOSE "NEW THREE-WIRE SYSTEM" IS IT?

IN your issue of June 15 I called attention to the fact that Mr. Rice's patent No. 463,364 covered the same subject-matter as Mr. Leonard claims under the title of "A New Three-Wire System." At that time I had not seen any patent issued to Mr. Leonard, and, in fact, cannot understand how the Patent Office could issue one consistently to Mr. Leonard, bearing in view the fact that Mr. Rice's patent issued before Mr. Leonard's was filed.

Mr. Leonard seems to think that Mr. Rice's invention is not operative. How he could arrive at that opinion after a careful reading of the patent it is difficult to understand. The patent is perfectly clear throughout, and Mr. Leonard might easily have discovered that the reversal of the field, which he lays so much stress upon, means the reversal of the *current* of the *series field*. In fact reversal of the field is impossible, since both the shunt and series field are co-operating under the conditions referred to, and the field strength is consequently at a maximum, and this condition is even expressed in the extract which Mr. Leonard has seen fit to make. Mr. Leonard after quoting this extract, says,—"The specification is very hazy in parts and seems to give rise to indications of serious doubt in the mind of the inventor of just what will occur," etc. This may be the condition of Mr. Leonard's mind in relation to the matter, but I submit that other inventors find the specification unusually clear. I am led to think that Mr. Leonard could not have read and pondered the following statement concerning the function of the compensating machine in Mr. Rice's patent.

"An initial excitation of the field of this machine is secured by a winding S^1 in shunt across the generator mains, but it may be replaced by other means of excitation, or, in fact, any arrangement securing a practically constant initial magnetism, which is *cut down* or *increased* by the current present in the winding D^1, according to the direction of the flow." D^1 is the small series winding which either cuts down, or, at other times, increases the field magnetism given by the shunt or constant excitation, according to the direction of flow in the series turns, which is reversed as the load shifts from one side to the other of the system, and this is the reversal which Mr. Leonard seems to think renders the system inoperative.

He says,—"But the reversal of the field is emphasized several times as an essential feature and is claimed distinctly," etc. This is decidedly not true. Such reversal is not emphasized, nor is it referred to "several times," but if Mr. Leonard will read the description in the specification carefully he will have no difficulty in understanding the nature of the invention. Fairness in criticism is demanded in order that such criticism should command respect.

Mr. Leonard quotes claim 3 of Mr. Rice's patent. He does not, however, quote claim 1, claim 2, or claim 4, which all relate to the same system, and which are thoroughly distinct and clear, as covering broadly Mr. Leonard's so-called new three-wire system.

It is hardly worth while to carry this discussion further. I would only call Mr. Leonard's attention to claim 2 of Mr. Rice's patent, and especially to claim 4. Mr. Leonard has called attention to claim 3, in which the words "so wound that its field is reversed," etc., occur. The claim is to be interpreted by the specification, and it will be seen that the field to be reversed is the series field alone, as I have already pointed out.

I am at a loss to see what my use of a motor generator, as contemplated in my patent No. 360,125, has to do with the subject under discussion, except that the system which Mr. Leonard describes would also be subject to the claims of that patent, though I will state, for Mr. Leonard's information, that notwithstanding the losses due to field excitation, friction, heating of the armature, etc., a motor-generator can be and has been so compounded, by the use of a small amount of series field, as to compensate for these losses and to maintain an exact balance between the two sides of a three-wire system.

I would call Mr. Leonard's attention to a patent to Mr. E. M. Bentley, No. 430,060, which, I believe, clearly covers certain features of his so-called new three-wire system, in addition to Mr. Rice's and my own patent referred to. I would also add in closing, without caring to refer to a number of minor matters, expressed in such statements as,—"the best relays for such purposes require two volts in pressure to actuate them, etc.," that the fact that a central station has been operating under the system which Mr. Leonard calls *his* system, for six months, does not in any way change the aspect of the case so far as the origination of the system is concerned. Mr. Rice's patent was filed February 13, 1891, and issued September 29, 1891. Mr. Leonard's patent was filed December 28, 1891, and issued June 7, 1892.

I have no wish to further prolong a discussion which any fair-minded person may settle by reference to the patents themselves, and in my former communication I merely called attention to the existence of these patents. ELIHU THOMSON.

LYNN, Mass., June 27, 1892.

DR. JACQUES' EXPERIMENT ON "WHAT ELECTRICITY IS."

IN THE ELECTRICAL ENGINEER for June 22, Mr. Townsend Wolcott in commenting on Dr. Jacques' experiment, sets himself up in opposition to Prof. Maxwell, to Dr. Jacques and to the writer. He thinks Maxwell's reasoning in leading up to this experiment was fallacious; that Dr. Jacques' conclusions from the experiment are incorrect, and that the writer is at fault in his interpretation of paragraphs 769 and 770 of Maxwell's celebrated treatise on electricity.

Prof. Maxwell is dead and cannot answer Mr. Wolcott's criticisms; Dr. Jacques seems rather inclined to let his experiment speak for itself than to enter into controversy, and it therefore remains for the writer to show that Mr. Wolcott is himself in error.

Prof. Maxwell in his "Electricity and Magnetism," paragraph 769, calculates out the mathematical expression for the mutual action between two parallel electrified surfaces moving together relative to some fixed point in space. Dr. Jacques takes up the problem here and shows by experiment that if the two parallel electrified surfaces be plates of brass and if the physical substance relative to which they move be the ether, the quantitative relations predicted by Maxwell will obtain.

Now, when we consider only the relative motion between the plates and the ether, it evidently makes no difference whether the plates move relative to the ether or the ether moves relative to the plates; it is wholly a question of relative motion. Since therefore Dr. Jacques' experiment shows that a current of ether flowing between the electrified brass plates exhibits both qualitatively and quantitatively the same properties as an electric current, it would seem to allow of no other logical conclusion than that a current of ether and a current of electricity are one and the same thing.

In paragraph 770 Prof. Maxwell calculates out the mathematical expression for the action of an electrified plate moving relative to a magnet, quite a different thing, though perhaps not less valuable, and experiments to test this relationship were made by Prof. Rowland in 1876 and were received with great interest throughout the scientific world when published. The mathematical predictions of Prof. Maxwell, the celebrated experiment of Prof. Rowland, and the recently published experiment of Dr. Jacques, are all links in a beautiful chain connecting the unknown with the known. Briefly Prof. Maxwell made certain mathematical predictions; Prof. Rowland showed that a moving electrified body was equivalent to an electric current; Dr. Jacques has shown that an ether current is equivalent to a current of electricity and thus demonstrates what a current of electricity is.

Mr. Wolcott attempts to point out certain "trifling defects in Dr. Jacques' reasoning," and says, "The deflections which Dr. Jacques expected to get, and which he thinks he did get, depend upon the repulsion of similarly electrified plates being diminished, and the attraction of similarly electrified plates being increased."

Now the words here quoted show very plainly that Mr. Wolcott has not correctly read Dr. Jacques' address and has missed the very gist of the experiment, and moreover they show an alarming ignorance of electric phenomena on the part of Mr. Wolcott, else he would not talk about "the attraction of similarly electrified plates," a phenomenon which any school-boy knows does not exist. Mr. Wolcott's article seems to the writer to savor rather of pugnacity than of purely scientific criticism.

VICTOR M. BERTHOLD.

BOSTON, June 24, 1892.

JUDGE ACHESON'S LAMP DECISION.

I NOTICE in your editorial of June 29, on the decision of Judge Acheson, what have impressed me, without any careful analysis of the situation, as misleading statements.

Regarding "a practical and public use." If I understand the matter, this was not a use of a practical or successful incandescent lamp, but only of a practical and successful method of building up carbons. Judge Acheson very clearly draws this line of distinction, as I read his opinion, and hence the fact that this process, which is the only thing covered by the Weston patent, was exhibited practically and publicly by Sawyer and Man, does not seem to me to bear out your conclusion that Judge Acheson's remarks have anything to do with Edison's subsequent success in the use of a filamentary carbon placed in an all-glass receiver exhausted of air.

Again, you say, "nearly all the incandescent lamps now made contain carbons which have been treated by the hydrocarbon process." Would it not be interesting in this connection to consider what proportion of the total number of the lamps manufactured to-day in the United States is produced at the factory of the Edison Company at Harrison, where no lamps are or have been commercially made by the treatment process? Of course the paragraph from which I make this quotation has no force unless it is limited to a consideration of the lamps made in this country alone.

Again you say, "the finding is directly contrary to that of the late Judge Bradley, in the McKeesport fibrous carbon case, who, on precisely the same evidences of fact, held that the work of Sawyer and Man," etc. The truth is that a considerable amount of new testimony as to questions of fact was taken in this Weston treatment case, and the record shows that in this branch of the case the evidence of the McKeesport case has been materially reinforced.

HYDRO-CARBON.

NEW YORK CITY, June 30, 1892.

ELECTRIC LOCOMOTIVES—A CORRECTION.

A PASSAGE in the newly published fourth edition of my "Dynamo-Electric Machinery" requires correction, being technically inaccurate. On page 616 the statement occurs that the electric locomotives of the South London Electric Railway are now being replaced by some of Messrs. Siemens' locomotives. In justice to Messrs. Mather & Platt it ought to be stated that the fourteen original locomotives supplied by them are still running, and that they have run in the aggregate not less than 450,000 miles. The two more recent locomotives supplied by Messrs. Siemens do not replace, but are supplementary to, the original engines.

SILVANUS P. THOMPSON.

LONDON, June 1, 1892.

THE NEW ELECTRICAL MONTHLY, *The Popular Electrician*, is to make its first appearance at Chicago June 15.

Literature.

DIGEST AND CLASSIFIED INDEX OF ELECTRICAL PATENTS.

WITH a view to affording attorneys, experts and others interested in electrical subjects a means of keeping abreast of the times and of prosecuting searches with ease and least expenditure of time, The Electrical Digest Publishing Company is about to issue a digest and classified index of all patents relating to electricity. The *Digest* will be issued monthly and will embrace a synopsis of each patent relating to electricity granted during the month.

A sample of the *Digest* before us shows great care in preparation and the illustrations accompanying the briefs lend it an additional value. The *Digest* will be published under the managership of Mr. R. W. Pope, No. 12 West 31st street, this city, and the first number will be issued August 9. The subscription price for the United States and Canada is $5 per annum; foreign countries, $7.50. There ought to be a large field for this publication and it deserves all the encouragement which can be given it.

Personal.

MR. A. L. ROHRER, of the Thomson-Houston Electric Company, of Lynn, well known to every electrical engineer, has just completed arrangements by which he will be transferred to Schenectady in the interests of the General Electric Company. His position there will be very similar to the one he leaves, and he will hereafter assist Mr. Kruesi in the same manner as he has assisted Mr. Rice for years past. For the next month or two Mr. Rohrer will divide his time between Schenectady and Lynn, but in the fall will settle down in Schenectady for good. Mr. Rohrer will be much missed in Lynn and Boston, as he has made hosts of friends and has occupied quite a prominent position in public affairs in the former city, being now a member of the board of management of the Lynn hospital and a member of the executive committee of the Lynn Board of Trade, having been its first president. A few notes regarding Mr. Rohrer's previous history, together with his portrait, will be found in our last issue in the article descriptive of the Lynn factories of the Thomson-Houston Electric Company.

PROF. F. B. CROCKER, vice-president of the Crocker-Wheeler Electric Company, New York, sailed June 18, in the steamer "Etruria" for Europe. While abroad he will meet all the prominent English and Continental engineers, to get, if possible, the results of their latest experiences in central station and power transmission work, and to compare notes on electrical matters in general, making a special study of improvements in electric motors with a view of introducing anything of value into his own practice.

MR. T. C. FRENYEAR, agent for the General Electric Company in New York State, with headquarters at Buffalo, has recently resigned his position to associate himself with the Cayadutta Electric Railroad Company, which is to connect Gloversville, Johnstown and Fonda, and is to do a general railway, as well as street railway business. Mr. Frenyear was secretary of the road at its inception, but has now become its general manager. Work will begin on the road in July. About $400,000 will be invested.

DR. CARL HERING, of Philadelphia, was married on June 30, in this city, to Miss Harriet B. Truesdell, also of Philadelphia. Dr. Hering expects to spend part of his honeymoon this summer in Switzerland, and will take with him the congratulations and best wishes of a host of friends.

Obituary.

JEREMIAH BORST.

A DISPATCH from Cobleskill, N. Y., under date of June 22, announces the death at that place, by suicide, of Jeremiah Borst, an old and well-known employee of the Western Union Telegraph Company in New York City. In the early part of 1867, Mr. Borst established *The Telegraphic Journal*, a weekly publication which was at the time supposed to have been issued under the auspices of the Western Union Telegraph Company, as it at once proceeded to wage vigorous contest against *The Telegrapher*, an independent journal which had been very outspoken in its criticisms upon the management and policy of that corporation in respect to its employees. Mr. Borst displayed considerable ability in the conduct of the *Journal*, but its career was brief. In November of the same year, it suspended publication, and its plant was taken possession of by the Western Union Company, which immediately thereafter commenced the publication as an official organ of the *Journal of The Telegraph*, under the editorship of J. D. Reid.

Inventors' Record.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JUNE 21, 1892.

Alarms and Signals :—

Means for Preventing Collisions on Railways, H. G. Held, 477,212. Filed Nov. 19, 1888.

A system of automatic electric alarms for steam railways.

Electric Controlling Apparatus for Fire Alarms, G. Knowles, Jr., 477,214. Filed Dec. 3, 1889.

Has for its object to electrically control fire-alarm mechanism without the intervention of a local battery or generator.

Conductors, Conduits and Insulators :—

Cable Junction Box, J. D. McLeod, 477,218. Filed Dec. 15, 1891.

Distribution :—

Distribution of Rotary Electric Currents, A. E. du Bois-Reymond, 477,250. Filed April 30, 1891.

Relates to a multiphase system where the currents equaling or exceeding three may be used to energize a rotary current motor and conveyed by the separate conductors used individually through lamps or the like requiring but one alternating current.

Dynamos and Motors:—

Electric Motor, F. Yeiser, 477,433. Filed Sept. 22, 1891.

Has for its object to reverse the direction of rotation of the motor by the simple adjustment of the commutator brushes.

Heating:—

Electric Heater, C. E. Carpenter, 477,628. Filed Nov. 29, 1890.

Has for its object to utilize a portion of the secondary circuit of a transformer as the heated resistance for evolving heat upon the passage of a varying current through the primary circuit.

Lamps and Appurtenances :—

Carbon-Rod Contact for Arc Lamps, C. McNellis, 477,219. Filed Jan. 26, 1892.

Employs a tube detachably secured to the floor of the lamp, a contact brush and a ring pressing the flange of the contact brush against the end of the tube.

Electric Arc Lamp, L. Parker, 477,221. Filed July 13, 1891.

Has for its object to discharge the upper carbon when consumed and insert a fresh carbon automatically.

Electric Arc Lamp, N. F. Rutherford, 477,273. Filed Aug. 12, 1891.

Employs two pairs of solenoids one on the main circuit of the lamp and the other in shunt; carbons carried by levers pivoted at their point of intersection, one carrying the main magnets and the cores of the shunt magnets and the other carrying the shunt magnets and the cores of the main magnets.

Incandescent Electric Lamp Socket, J. S. Gibbs, 477,407. Filed Feb. 27, 1892.

Consists of a shell with a single division of insulating material supporting conductors to which the circuit wires are joined.

Electric Arc Lamp, F. V. Maquaire, 477,427. Filed Aug. 13, 1891.

Employs an electromotor automatically operating both carbon holders and an electro-metric balance regulating the motor.

Measurement :—

Means for Operating Ammeters and other Electrical Apparatus, H. M. Pilkington and R. S. White, 477,223. Filed Sept. 24, 1891.

Claim 6 follows:

The combination in an ammeter or indicator of several coils in separate line wires, a single pointer, a single scale, and means acted upon in conjunction by said coils for moving said hand or pointer.

Metallurgical :—

Process of Electroplating with Alloys, E. T. Burrows, 477,350. Filed Nov. 7, 1891.

Employs a solution of copper sulphate, caustic potash, zinc sulphate, chloride of tin, sal ammoniac and muriate of iron and an anode of copper, tin and zinc.

Miscellaneous :—

Electric Alarm Clock, B. Franklin, 477,206. Filed Sept. 12, 1891.

Rheostat, G. K. Cummings, 477,247. Filed Dec. 11, 1891.

Employs an electric conductor of high resistance embedded in a block of moulded insulating material.

Electric Jail, P. Hale and C. H. Sparks, 477,301. Filed Sept. 7, 1891.

Relates to electric alarm mechanisms for jails.

Thermotic Circuit Closer, W, H. Tapley, 477,315. Filed Aug. 14, 1889.

Has for its object to facilitate accurate adjustments of devices by which electric connection is made with a thermostat.

Electric Embossing Stamp, C. E. Carpenter, 477,627, Filed June 21, 1890.

Switches and Cut-Outs :—

Electrical Switch, C. J. Klein, 477,374. Filed May 28, 1891.

A quick-break jack-knife switch.

Electric Switch, J. L. Hinds, 477,595. Filed July 23, 1891.

Has for its object a simple and effective switch highly economical in manufacture.

Electric Switch, E. T. Greenfield, 477,409. Filed Dec. 16, 1891.

A snap switch provided with a spring-actuated arc interrupter of insulating material.

Electric Switch, E. A. Snow, 477,612. Filed July 23, 1891.

Employs a spring composed of a plate folded upon itself and a cam for engaging the central portion of said spring and forcing it into contact with the terminals.

Telegraphs:—

Printing Telegraph, C. J. Reed, 477,383. Filed May 27, 1891.

Employs a combination of a telegraph circuit with two or more type-writing machines.

Printing Telegraph, C. J. Reed, 477,384. Filed July 6, 1891.

Similar to 477,383.

Telephones and Apparatus :—

Test Circuit for Multiple Switchbords, C. E. Scribner, 477,579. Filed May 12, 1885

Employs a battery in the ground circuit at the central office and testing apparatus at the different boards to determine at any board whether a line is in use at any other board.

Electric Annunciator Drop, J. C. Warner, 477,616. Filed June 17, 1889.

Employs a soft iron shield about the coil to prevent inductive effects between the coils of the different magnets when placed near each other.

TRADE NOTES AND NOVELTIES

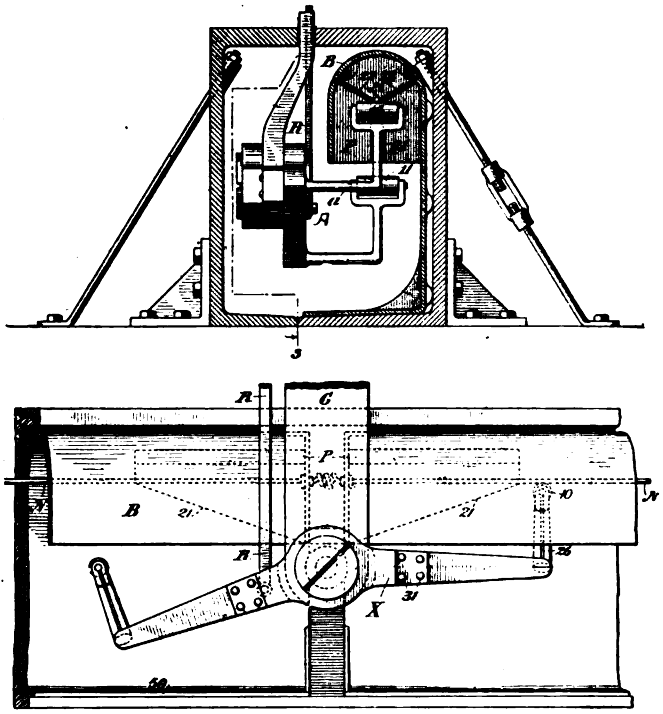
AND MECHANICAL DEPARTMENT.

When an eye first sees your advertisement it may appeal to the eye only; it is only in repeated efforts that advertising reaches its object—the customer.— D. T. Mallett.

THE "DIVING BELL" CONDUIT FOR ELECTRIC RAILWAYS.

THE accumulation of water and sediment in electric railway conduits has been a fruitful source of trouble that has gone far toward preventing their adoption. Almost all devices intended to remedy this defect have aimed at keeping the water out and have neglected the important point of the protection of the wire in case, through some unforeseen accident, it should effect an entrance. A very different plan however is that devised by Mr. R. W. Barkley, of this city, and shown in the accompanying illustrations.

As will be seen, the key to the system is the adoption of the diving bell principle, the conductor N being within a series of diving bells B, which open into the conduit C, such as that used on the cable railway. The diving bells effectively prevent water or mud from rising to the wire and causing grounds.

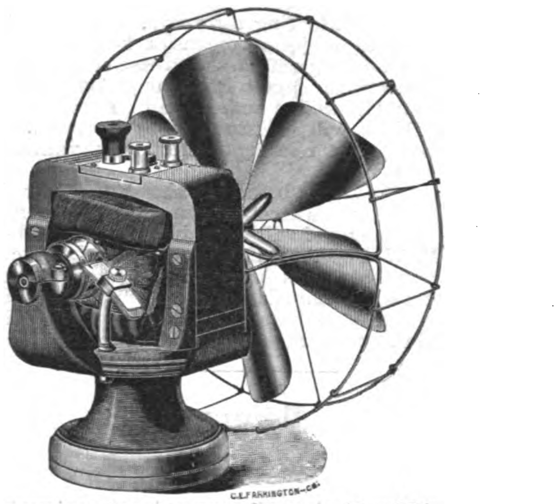


FIGS. 1 AND 2.—"DIVING BELL" CONDUIT FOR ELECTRIC RAILWAYS.

Between the diving bells, the wire is suitably insulated. The trolley A, having two trolley rollers 10 and 11, is pivoted to a support G from the car or truck. In the position of the parts shown, roller 10 is in connection with the motor, while roller 11 is dead; with roller 11 up and roller 10 down, matters are reversed in these respects. The inclines, 21, at each end of the diving bells, cause the working roller 10 in the case shown, to duck under the end walls P, of the diving bells while the rod R is used to raise and hold either of the rollers in contact with the conductor N.

THE BERNSTEIN ALTERNATING CURRENT FAN MOTOR.

WE illustrate on this page, a new motor of the alternating current type, for fan work, just brought out by the Bernstein Electric Company, of 620 Atlantic avenue, Boston. It will be remembered that the Bernstein continuous current motor was also noticed in our columns recently. This new little machine is known as the "T" type. It is ⅛ h. p., stands 9 inches high without the fan, runs at a speed of 1,600 revolutions, and consumes only 65 watts. It is wound for either 50 or 100-volt circuits, and for other special voltages if desired, It has but one brush, with bronze commutator, and self-oiling bearings. The fan is a 12-inch, and delivers a most refreshing breeze. The motor runs noiselessly and with a minimum of heat. It will also stand an overload without undue heating or danger of burning out. The company is desirous of securing agents for its fan motors in every town in the country.

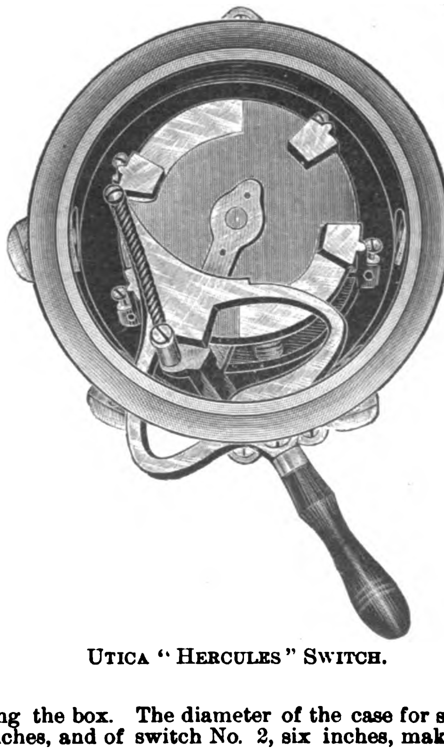


BERNSTEIN ALTERNATING CURRENT FAN MOTOR.

THE UTICA "HERCULES" SWITCH.

THIS cut shows the "Hercules" switch, made and sold by the Utica Electrical Mfg. & Supply Co., Utica, N. Y. It has double contacts—is quick acting and can be used either on arc or power circuits. It has heavy binding posts and contacts, is mounted on slate base and enclosed in a water-tight iron case, and currents from 25 to 100 amperes of high voltage can be safely handled, causing hardly a perceptible arc. The switch is of new and original design, and is automatic in its action when started in either direction.

"The "make or break" of contacts is not dependent on slow or fast movement of the operator's hand. The case is provided with porcelain bushings for the protection of wires in entering and leaving the box. The diameter of the case for switch No. 1, being 8 inches, and of switch No. 2, six inches, makes it a most compact article.



UTICA "HERCULES" SWITCH.

THE SECHRIST AUTOMATIC CONTROLLER FOR INCANDESCENT LIGHTS.

A valuable patent was granted to Albert Sechrist of Denver, Col., on the 7th day of June, which covers a new system of controlling electric lights. The system is similar to that used in electric gas lighting and, in fact, answers the same purpose for controlling electric lighting as the automatic gas burner. The system is a combination of an automatic switch, push buttons and an ordinary battery, or shunt circuit. The automatic switch answers the same purpose as an ordinary switch, but instead of being operated by hand it is controlled by push buttons the same as gas keys located at any number of different points. The switch is simple in construction as is seen by reference to Fig. 1, while Fig. 2 shows the whole circuit. The white buttons operate a magnet which turns on the light, and the black buttons operate a similar magnet which releases a spring and turns off the switch. The system is especially adapted for residence lighting and in that capacity gives a great range of possibilities. The switches are located in some out-of-the-way place and only the neat and ornamental push buttons are to be seen, located conveniently on the door casing at the entrance to the various rooms. Besides presenting a much neater appearance, the same light may be controlled from any number of different points. This is often a great convenience; take for example the second-story hall light, which may be operated from the first, second and third story halls and also from each of the chambers on the second floor. In this way a person may pass through the house in any direction without the necessity of ever being in the dark, as by simply touching a button, here or there, it will turn on the light ahead or extinguish the light no longer needed.

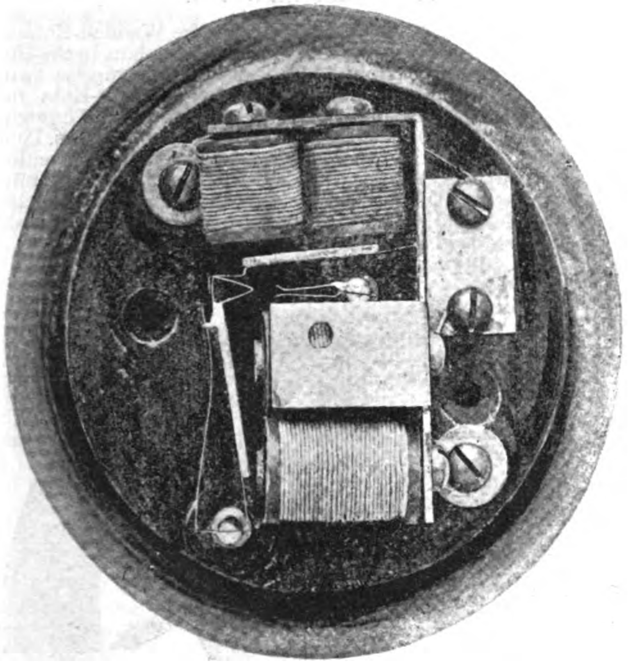


FIG. 3.—SECHRIST AUTOMATIC CONTROLLER.

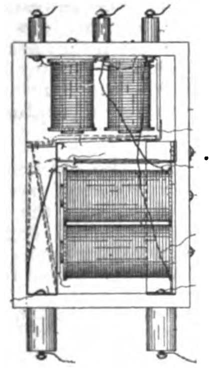


FIG. 1.—SECHRIST AUTOMATIC CONTROLLER.

A set of buttons may be located in the chamber to control the entire house. The porch, hall, parlor and library lights may be controlled from the front and side entrances. The system is also useful as a burglar alarm; the wires may be attached to the ordinary burglar alarm system of the house and whenever a door or window is open the light is automatically turned on, to the utter rout and confusion of the burglar; or the wires may be attached to an ordinary clock; the light will be turned on or off at any desired time.

Although the system has only been in use six months in Denver, over 50 residences are being lighted with the Sechrist automatic switch, and the prominent architects are specifying the same for new residences that are being built.

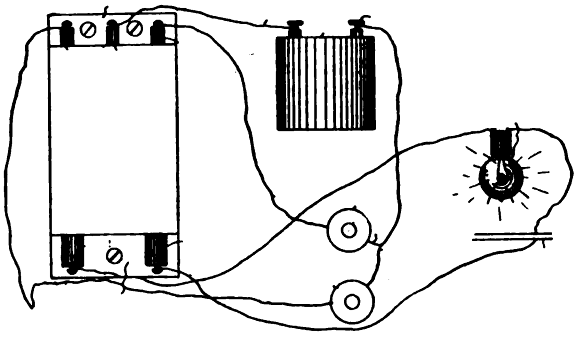


FIG. 2.—SECHRIST AUTOMATIC CONTROLLER.

Fig. 3 shows a new and very convenient form of the switch, with regular metal cap screwed on; and the whole mounted on a fine porcelain base. In the engraving, the cap has been removed. The screw holding the cap engages in the small hole shown in the flat leaf covering one of the magnet spools.

THE JOHN L. GISH IDEAL RHEOSTAT.

THE accompanying illustrations show a rheostat designed by Dr. John L. Gish, of Jackson, Mich., to meet the needs of surgeons and dentists. The form shown in Fig. 1 is intended for use in connection with electric mallets, mouth lamps, etc., and will furnish a sufficiently strong current to treat all diseases of the teeth and mouth.

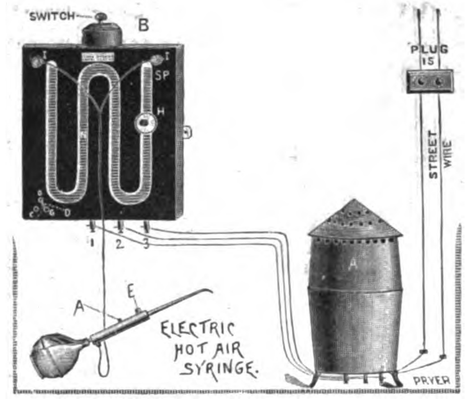


FIG. 1.—THE JOHN L. GISH IDEAL RHEOSTAT.

Fig. 2 represents a larger rheostat for faradic work, both therapeutic and diagnostic, and is also claimed to operate the electromagnet to a remarkable degree of nicety. A gradual change of voltage from zero to 80, and of ampereage from zero to 2¼ can be obtained. In another form of this device, designed for cautery work, the arrangement is such that the voltage may be diminished and the current increased to meet all requirements.

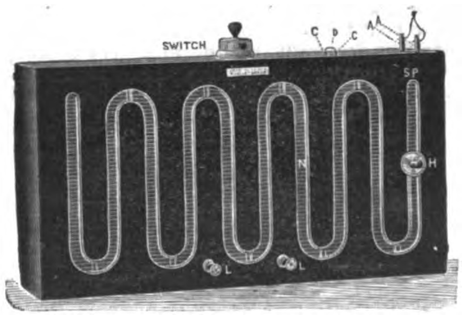


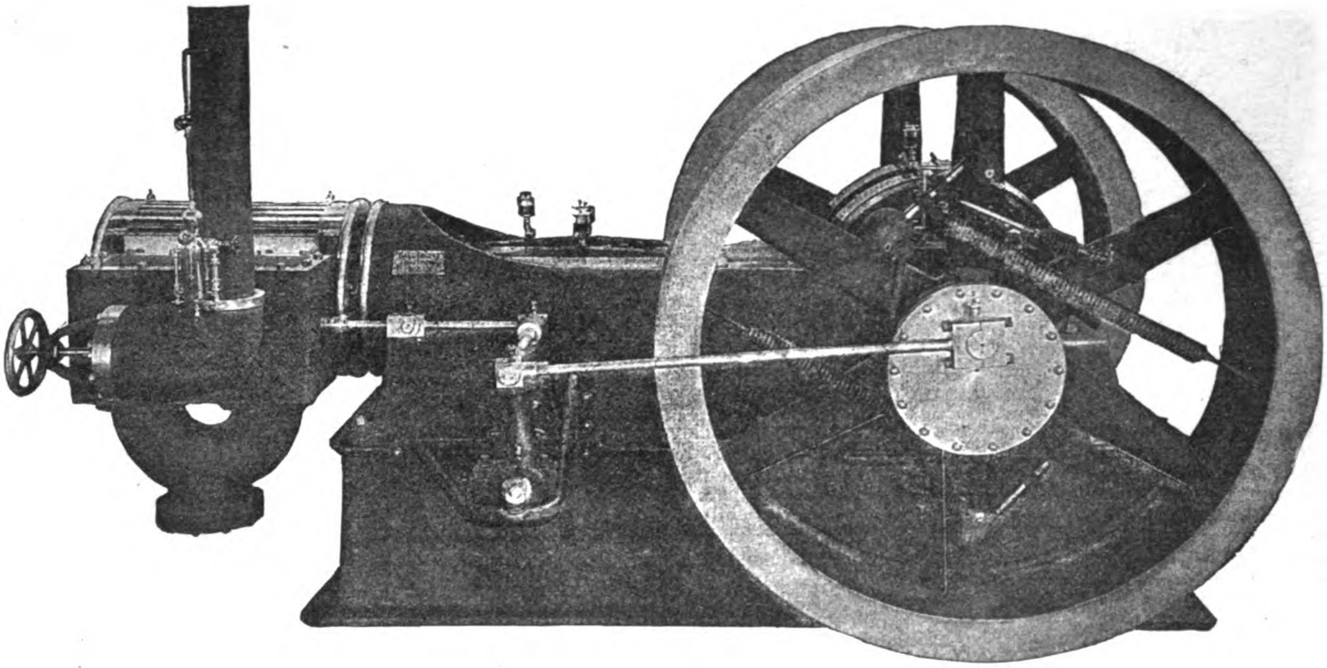
FIG. 2.—THE JOHN L. GISH IDEAL RHEOSTAT.

The rheostat is placed in the street circuit, while the operator takes from a shunt a current of the character best suited to his particular work. The instrument is attractive in appearance and is mounted in a handsomely finished black enamel case.

HEAVY DUTY BALL ENGINE FOR ELECTRIC RAILWAY SERVICE.

The extremely varying load which a steam engine in an electric railway power station is so often called upon to carry calls for the fulfillment of special conditions, prominent among which are great strength and prompt acting of the governing mechanism. It is through lack of one or both of these essential points that some of the engines in the early installed stations have shown themselves unfit for the task assigned them.

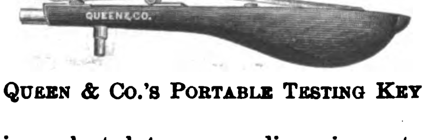
In the accompanying illustration is shown an engine recently brought out by the Ball Engine Co., of Erie, Pa., especially for electric railway service. It will be seen that this engine is, for its cylinder capacity, of great strength and weight, the makers claiming that the engines they build are, for the horse power, the heaviest engines made. The connecting rod and crank shaft are of forged steel. The crank shaft is 8 inches diameter in the crank pin and in the journals. The crank pin boxes are lined with strictly genuine babbitt; the cross-head boxes are of pure copper and tin. The cross-head pin is of tool steel. The system of oiling the running parts is very simple and thorough. The valve which has been used by this company with such great success in the past in their electric light engines, is continued in the "Heavy Duty" engine. This engine has shown in practice perfect regulation under conditions where the variation in load on the generator from zero to the full capacity has occurred during less than five seconds of time. The makers of this engine, working on the theory that the electric railway interests demand a strictly first-class engine, are using the very best possible material and workmanship throughout, and claim to give perfect satisfaction.



Heavy Duty Ball Engine for Electric Railway Service.

QUEEN & CO.'S PORTABLE TESTING KEYS.

While practically all galvanometer and other electrical keys are portable in that they can be carried about, yet the type illustrated herewith is decidedly unique and very useful. Every one who has occasion to make insulation tests away from a laboratory knows how essential it is to have apparatus that is reliable, and at the same time adapted to surrounding circumstances; that is, accuracy must be combined with portability.



Queen & Co.'s Portable Testing Key.

A short-circuit key or a contact key that can be thrust into one's pocket will commend itself for convenience to those engaged in outside work, and we are informed by Queen & Co., of Philadelphia, that they can "fill the bill" with their new products. The keys are made of hard rubber, polished, with brass connections, and platinum contacts, and the desired effect is produced by simple pressure of the hand.

As to "weights and measures," none are longer than 5½ inches, and they weigh not over five oz. each. Three forms are now made, viz., single contact, double contact and short-circuit. A full description with price-list will be found in circular No. 340 just issued by Queen & Co., which will be forwarded upon request.

PHILADELPHIA NOTES.

Messrs. Wright & Starr, agents for the Waddell-Entz Co., have the contract for installing an electric light plant in the Union League Club of Philadelphia. The plant will comprise two 80 kilowatt direct-coupled generators of the Waddell-Entz make driven by two Straight Line engines of 120 h. p. each. The switchboard, which will be a model one, is being built by Messrs. Pepper & Register. The limited space for machinery and the condition of things about the building renders this plant a most difficult one to engineer. Dr. W. A. Drysdale, the consulting electrical engineer, is doing himself credit in this undertaking after its having been abandoned by several other engineers.

The Heisler Electric Co.—In response to a letter sent out by the Heisler Electric Co. to numerous plants installed by them throughout the country wherein they ask to be informed as to the dividends declared to stockholders, they have received many very gratifying letters stating the appreciation of the working of the Heisler long-distance lighting apparatus and quoting dividends ranging from 7 to 22 per cent.

Dr. W. A. Drysdale.—The electrical equipment for "The Stentor," the new hotel in process of erection at Broad and Spruce streets, has been completed under the direction of Dr. W. A. Drysdale, the consulting electrical engineer. The building is wired for 550 lights, Vulca tubing being used throughout. The Novelty Electric Co., have the contract for the work.

A baseball nine, composed entirely of employees of the factory of the Partrick & Carter Co., will challenge to play a nine from any other electrical company in the city.

WASHINGTON NOTES.

The Washington Electric Conduit Co. find that a great many companies are in the market for a good and cheap conduit system that shall enable them to put their wires underground, and hence the summer with them is busy. Mr. Wilmot Lake, their engineer, has left Washington on a trip through Cincinnati, St. Louis, Chicago, Minneapolis, Detroit, Buffalo, Rochester, Albany and other points, to look after the company's interests in those places.

A GREAT ENGINEERING ENTERPRISE IN JAPAN.

THE last mail from the Orient brings a very interesting account of the completion and successful operation of a great government work in Japan. Lake Biwa, having an area of 500 square miles, is located seven miles from the city of Kioto and at an elevation of 143 feet.

A navigable canal has been cut from this lake to Kioto, involving two miles of tunneling and an aqueduct of considerable length. At the eastern extremity of the city, to which point the canal has been brought, there is a sharp decline of 118 feet, from the base of which the canal is continued to the sea. This difference in level is overcome by inclined planeways 2,100 feet in length, on which boats are raised and lowered from one canal to the other. These ways are operated by electric power furnished from a Pelton water-wheel connected with a Sprague motor.

The fall above named affords also a very valuable water-power, a part of which has already been utilized for various mechanical purposes by means of electric transmission. The power station is located at the foot of the incline, and consists of three 8-foot and two 6-foot Pelton wheels, aggregating about 600 h. p., which are supplied with water from the high-level canal by three lines of 36-inch pipe, 1,300 feet in length, delivering water to the wheels under a head of about 100 feet.

These wheels are at present operating three Edison dynamos of 80 kilowatts each, the power from which is distributed about the city within a radius of two miles, running rice mills, spinning mills, a watch factory and various other machinery. One Thomson-Houston alternating current dynamo of 2,000 volts supplies the city with 1,300 incandescent lights, as well as many arc lights.

The above works, involving an expenditure of $1,500,000, were planned by and executed under the direct supervision of Mr. S. Tenabe, an eminent Japanese engineer, and their operation is said to be a great success, both from a mechanical and a financial point of view.

PURITY OIL FILTER MFG. CO.

THE PURITY OIL FILTER MFG. CO., of Pittsburgh, Pa., recently shipped the Schmulbach Brewing Co., Wheeling, W. Va., one No. 2; the Pearson Cordage Co., Boston, Mass., one No. 4; Crook, Horner & Co., Baltimore, Md., one No. 2, Ideal oil refiners. They have a letter from San Francisco, Cal., saying their Ideal oil refiner at the Pacific Rolling-Mill is doing splendid work; that the oil contains 3 per cent. of sand, cinders and ashes before being purified, and that a powerful magnifying glass fails to reveal any of it after refining. The following from Pittsburgh is also of interest:

PITTSBURGH, PA., June 1, 1891.

PURITY OIL FILTER MFG. CO.

Gentlemen.—The Ideal steam oil refiner you placed in the power house at Oakland for this company last March, is giving good satisfaction, and is saving us a large amount of oil. The oil is a better lubricant after being used on the engine, and purified under your process, than when first taken from the barrel. We use it on the pins of our large Wetherell-Corliss engines with splendid success. I think you have the best waste-oil reclaimer I ever saw. I have used a number of different devices in my capacity as erecting engineer. I will recommend the Ideal refiner to my friends, and wish you the success that this invention merits.

Yours truly,

JAMES GORMAN,
Chief Engineer Pittsburgh Traction Co.,
Late Erecting Engineer for Robert Wetherell & Co.,
Chester, Pa.

R. THOMAS & SONS.

THE firm existing during the past nine years under the name of R. Thomas & Sons, and manufacturing porcelain at East Liverpool, Ohio, has merged into an incorporation which will be known hereafter as the R. Thomas & Sons Co.

This company have recently purchased from the Westinghouse Electric Co. their entire porcelain plant which, with their already large factory, employing over 200 operatives, gives them, it is claimed, the most extensive works in this country making porcelains for electrical purposes a specialty. They have just issued an elaborate catalogue of 45 pages illustrating over 200 designs of porcelain used in the electrical trade, but which does not include one-third the variety they are making. It is very essential that all porcelain for electrical purposes should be very hard and vitreous. The Thomas Co. pride themselves upon making throughly non-absorbent goods.

F. P. LITTLE & CO.

F. P. LITTLE & CO., of 141 East Seneca street, Buffalo, N. Y., have closed a contract for lighting the new Columbia Theatre at Binghamton, N. Y. The plant will consist of an "H. I." Thomson-Houston dynamo, with wiring complete for 600 lights, and all the regulators necessary for stage lighting and special effects. Mr. Little has also sold a 90,000-watt Thomson-Houston dynamo for the new Capitol Building at Albany. Business is quite brisk with the company, and looks as though it would continue so indefinitely.

A NEW ELECTRICAL DICTIONARY.

MESSRS. NORMAN W. HENLEY & CO., the publishers of scientific books, 150 Nassau street, New York, have nearly ready for publication "*The Standard Electrical Dictionary*" by Prof. T. O'Conor Sloane, author of "*Arithmetic of Electricity*," "*Electricity Simplified*," *etc., etc.* The author's previous works have been endorsed very highly by the press. He is very well known, and will, no doubt, produce a work of merit. Further information in regard to same may be had by addressing the publishers.

NEW YORK NOTES.

NEW STOCK COMPANIES are formed daily in every State, and they all must have a book of stock certificates. The most effective certificates can be procured, at the smallest cost, by using ready lithographed forms, which are adapted to the need of any corporation by the addition of a few printed lines. A. B. King, of 89 William street, N. Y., is headquarters for these certificates; he carries seventeen patterns in stock. He will furnish a book, at about one-third the cost of a specially lithographed one of inferior design, and can deliver it complete within three days. He has, also, forms for bonds, with ten to sixty coupons, which afford like advantage for providing handsome-looking bonds, quickly and at low cost.

WM. C. MCINTYRE & CO., agents for the Eddy Motor, report the following recent sales in Philadelphia: Singer Sewing Machine Co., 7½ h. p.; Penn. Mutual Ins. Co., 10 h. p.; E. K. Tryon & Co., 5 h. p.; J. E. Ditson & Co., 5 h. p.; Buchler, Bonbright & Co., 4 h. p. At Wilmington, Del., *Evening Journal*, 10 h. p.; Heyson & Co., 5 h. p. At Allentown, Pa., Breinig & Bachman, 10 h. p.; Bitner & Hunsinker, 7½ h. p.; Allentown Shirt Co., 3 h. p. Mr. McIntyre says they have been compelled to refuse several orders during the last three weeks on account of not being able to procure machines from the factory, where they are reported to be over one hundred machines behind on their orders.

THE OKONITE COMPANY are to be congratulated upon the continuous success of their high grade wire, the sales for the past week amounting to upwards of one million feet, through the hands of the Central Electric Company, their general Western agents. One single order amounted to 225,000 feet, besides a constantly increasing demand among the regular customers. The large stock held by the Central of all sizes of wires, coupled with the quality of the product is perhaps some reason for the favor with which the wire is regarded.

MR. A. C. WHITNEY will hereafter represent the Crocker-Wheeler Electric Co., and will find his large experience among central stations of great service to him. He was for some time connected with the Crosby Electric Co., and then joined the Consolidated Electric Storage Co. in the capacity of manager of agents. After this he became associated with the Union Electric Co. and succeeded in introducing their battery very widely.

MR. F. S. TERRY, the manager of the Electrical Supply Co., of Chicago, has been East on a visit during the sessions of the Democratic Convention in the big Wigwam, which stood right in front of his office windows. Had the building been of higher class construction, Mr. Terry thinks it might have answered fairly well for a convention of the customers of his company. No place smaller would suffice.

MR. A. L. TINKER has severed his connection with the Engineering Equipment Co. of this city, it being understood that he has sold out his interest in the concern. He has held the positions of secretary and treasurer.

MR. E. T. BIRDSALL, the well-known electrical engineer of this city, was married on June 22d to Miss Louise Banker, daughter of Mrs. Amanda Stevens Goetchius. The wedding took place at St. George's Church.

NEW ENGLAND NOTES.

DR. A. F. MASON, whose name is known to every one in the electrical trade, returned about two months ago from a winter sojourn in Florida, and related to a number of his friends a few interesting "fish stories." We were pleased, however, a few days ago, to accept an invitation to view one of the specimens of the doctor's prowess in the piscatorial art, and congratulated him upon a very fine tarpon which he had just received, handsomely mounted on a polished board. This fish weighed when caught 101 pounds, measures just 5 feet 10¼ inches long, and took the doctor just 55 minutes to land. It is a beautiful specimen of this noble fish, now getting somewhat scarce, and will, doubtless, be kept by Dr. Mason for many a long year as a memento of his fishing excursion in 1892.

The Westinghouse Electric Company through their New England agency are in receipt of the following orders: 100-light isolated plant for the Norman Paper Company, Holyoke, Mass.; an increase of a 60-light alternating current arc light dynamo with lamps for the Uxbridge and Northbridge Electric Company; an 800-light alternating incandescent dynamo for the new plant of the Stamford Electric Light Company, of Stamford, N. Y.; and four car equipments, single-reduction motors, for the Keokuk Street Railway Company, Keokuk, Iowa. The order for the alternating arc light dynamo is particularly interesting, as it is an increase and has been ordered by the Uxbridge Company on account of the satisfaction of the first apparatus installed for them.

Mr. **George R. Lean**, who has been for some years connected with the Bernstein Electric Company, of Boston, and who has had a long experience in the manufacture of incandescent lamps, has resigned from his position with that company, and has accepted a somewhat similar position with the Heisler Electric Light Company, of Philadelphia, who as is well known, make a specialty of long-distance series incandescent lighting. Mr. Lean's long experience in this particular line, will doubtless make him a valuable acquisition to the Heisler Company, and he enters his new field with the best wishes of all his friends in the East.

Mr. A. H. Trott, who has been for some time connected with the Thomson-Houston International Company, has just returned from Demerara, where he has had charge of the arc and incandescent station in the city of Georgetown. Mr. Trott has gone to his home in England for a short vacation, but expects to return in the fall. Mr. Trott is the son of Captain Trott, of the cable ship "Minia," well known to all electricians in Boston, New York and many other cities in this country.

The Redding Electric Company, of Boston have sent out a circular letter to the trade, notifying them that on account of the large increase in their trade for electric light specialties, they have decided to give up their household goods department. They have a large stock of these goods on hand, and desire to close them out at once at very low prices.

The Waterbury Brass Co., of Waterbury, Conn., are putting up their new wire mill, which will be of iron designed and furnished by the Berlin Iron Bridge Co., of East Berlin, Conn. The rolling mill will be 100 feet wide by 160 feet long, with a wing (to be used for drawing wire) 40 feet wide by 230 feet long.

The Davidson Fan Ventilating Company, of Boston have been offered the contract for furnishing all the fans to be used in the ventilating of the buildings of the World's Fair in Chicago. About 100 fans will be required, varying in size from 12 inches to 60 inches in diameter.

Mr. T. McCoubray, of "Okonite" fame, was in Boston during the past week, and tried to enliven things generally. Mr. McCoubray once lived in this section and is warmly remembered and welcomed by a large number of friends.

Mr. E. R. Weeks, of Kansas City, was in Boston during the past week, and met a large number of his friends while here, who were all glad to see him, as he does not frequently get so far East.

WESTERN NOTES.

The Electric Appliance Company are just at present rejoicing over the completion of their catalogue, and are very busy now distributing several thousand copies among the trade. They certainly have reason to be proud of their efforts as they have issued a very complete and attractive volume. It has been their aim from the start to produce a catalogue that would contain the greatest amount of information in the smallest possible space. How well they have succeeded is shown by the fact that in a catalogue 5 x 8 with 200 pages, they have included practically everything in the electrical supply line, giving a complete list of supplies in the following departments of the business: Electric light and power supplies, electric railway supplies, electrical house goods, fire-alarm supplies, telephone supplies, telegraph supplies, physicians' electrical supplies, electrical toys and novelties. That the catalogue will be appreciated by the trade goes without saying, as there has undoubtedly been a demand for a catalogue that would in a single volume cover all of the departments of the business.

The M. C. Bullock Manufacturing Co. have secured the order for a 250 h. p. Bullock-Corliss engine, three 100 h. p. steel boilers, and jack shaft and friction clutch pulleys, for the power plant of the Belle City Street Railway Co., Racine, Wis. They will also do the erecting and turn the plant over to the street railway company under steam. In addition the past week has brought the company orders for a 250 h. p. Corliss to go to Logansport, Ind., and a 350 h. p. Corliss for the works of Wm. Deering & Co. Besides these they have booked orders from New York City for seven large friction clutch pulleys fitted with their own friction device, which is being favorably received for use in electric light and street railway work.

The Central Electric Company report having sold during the past week 150,000 feet of assorted sizes of Interior conduit, with elbows, junction boxes and couplings. The Central Electric Company are the general Western agents for the Interior Conduit & Insulation Company, manufacturers of the tube, and carry a large stock of it on hand at all times, which enables them to fill orders promptly, and to meet the growing demand of the business. The Central Electric Company are selling large quantities of incandescent switches, and key and keyless sockets of approved manufacture at low prices. They keep a very large stock of these on hand, and do not delay their customers in filling orders, while the prices are at the lowest market rates.

The Buckeye Electric Co., of Cleveland, Ohio, makers of the Buckeye incandescent lamps for all classes of work, have received orders during the last two weeks from points as widely separated as California, Nova Scotia, Louisiana and New York. The area of use of Buckeye lamps widens daily and the orders grow in size, with corresponding rapidity. The company have offices in Chicago at 437 "The Rookery," and have now opened comfortable quarters in the new Mail and Express Building, New York City.

George Cutter reports some large sales of the Germania shade holders for which he is the Western agent.

PITTSBURGH NOTES.

Twenty-one electrical construction companies of Pittsburgh and vicinity have formed what is called The Master Electricians' Association of Allegheny County and have united on a uniform schedule of prices for all manner of construction work, which each and every one is compelled to adhere to under a heavy penalty.

The Supply Manufacturing Co., the enterprising builders of commutators, have, during the past week, received orders for commutators alone which will amount to several thousands of dollars. They have excellent manufacturing facilities, and are undoubtedly the most extensive builders of commutators in this country.

The R. D. Nuttall Co. have recently added several new gear cutting machines to their large factory in Allegheny and continue to run 22 hours per day. They report a large demand for their rawhide pinion gears and trolley poles.

The Miller Electric Construction Co. have taken the agency for Pittsburgh and vicinity for dynamos, motors and instruments manufactured by the La Roche Electric Works of Philadelphia.

Mr. William N. Famous of the Pennsylvania Electric Engineering Co., Philadelphia, is in the city and reports having taken several large orders for the Pennsylvania lamp.

The Washington Carbon Co. are receiving orders for carbons fully as fast as their factory can produce them, which is something unusual at this time of the year.

The Purity Oil Filter Manufacturing Co. are shipping large numbers of their oil refiners to central stations throughout the country.

SOUTHERN NOTES.

Newport News, Va.—The new power house for the Newport News Shipbuilding & Dry Dock Co., at Newport News, Va., will be designed and built by the Berlin Iron Bridge Co., of East Berlin, Conn., U. S. A. In order to have the building absolutely fireproof, no woodwork will be used about the construction, as the side walls will be of brick, the floors of iron and concrete, and the roof will be made with an iron frame covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron covering. The steam, compressed air, hot air and electric light plant for the entire shipyard is concentrated in this one building, and it is therefore absolutely necessary that it be fireproof in every particular.

BALTIMORE NOTES.

Crook, Horner & Co., Baltimore representatives of the Ball Engine Co., Erie, Pa., have recently furnished two 150 h. p. engines of this manufacture to the North Avenue Street Railway Co., Baltimore, and two 150 h. p. tandem compound condensing engines and complete steam plant to the Chesapeake Light and Power Co., Hampton, Va.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

VOL. XIV. JULY 13, 1892. No. 219.

A CENTRAL STATION METHOD OF LOCATING GROUNDS ON ARC CIRCUITS.

BY

Edgar E. Stark

ALL electrical circuits are subject to occasional grounds, and it is desirable to have these removed as soon as possible. A number of articles have appeared from time to time on the use of high resistance voltmeters, such as the Weston, in measuring the insulation resistance of incandescent circuits and dynamos while the current is on, but little has been said about locating grounds on arc circuits, while in operation; and the writer is therefore of the opinion that a description of the methods in use in a number of large lighting stations will prove interesting to station managers.

An apparatus is used consisting of a bank of thirty or more 100 to 120 volt lamps in series. These are arranged generally with contacts and a switch so that their number can be increased or decreased, after the manner described by Mr. M. D. Law in remarks made before the National Electric Light Association.

In this method one end of the series is connected to earth; the other has a flexible cable attached which is to be connected to either pole of the circuit under test. If the lamps glow when so connected, there is a ground or leak on the circuit. If the leak be through a high resistance then only a few lamps can be made to glow; if the leak be through a good earth connection it may make all the lamps glow from one or both terminals. Thus a rough estimate can generally be made of the location of the ground. In each test by the above method the resistance of the ground or leak is included as part of the bank of lamps circuit, and on a high voltage circuit of, say, 3,000 to 4,000 volts, this leak resistance is by no means constant even for a short time.

About two years ago the writer made an apparatus, utilizing the Wheatstone bridge principle with the object not only to detect a leak on an arc circuit but to locate it between lamps, irrespective of its resistance. It consists of two banks of 45 to 120 volt lamps, A and B, Fig. 1, connected in series, each bank with a metallic lever sliding over a series of segments connected to the junctions of the lamps in turn, as shown in dotted lines. An auxiliary switch *y* is arranged with two contact blades to touch two adjacent segments of the series, thereby straddling one lamp; the two blades are attached to a Weston voltmeter, which can thus read the voltage of each lamp in the series. I use 120 volt lamps on account of the small current they

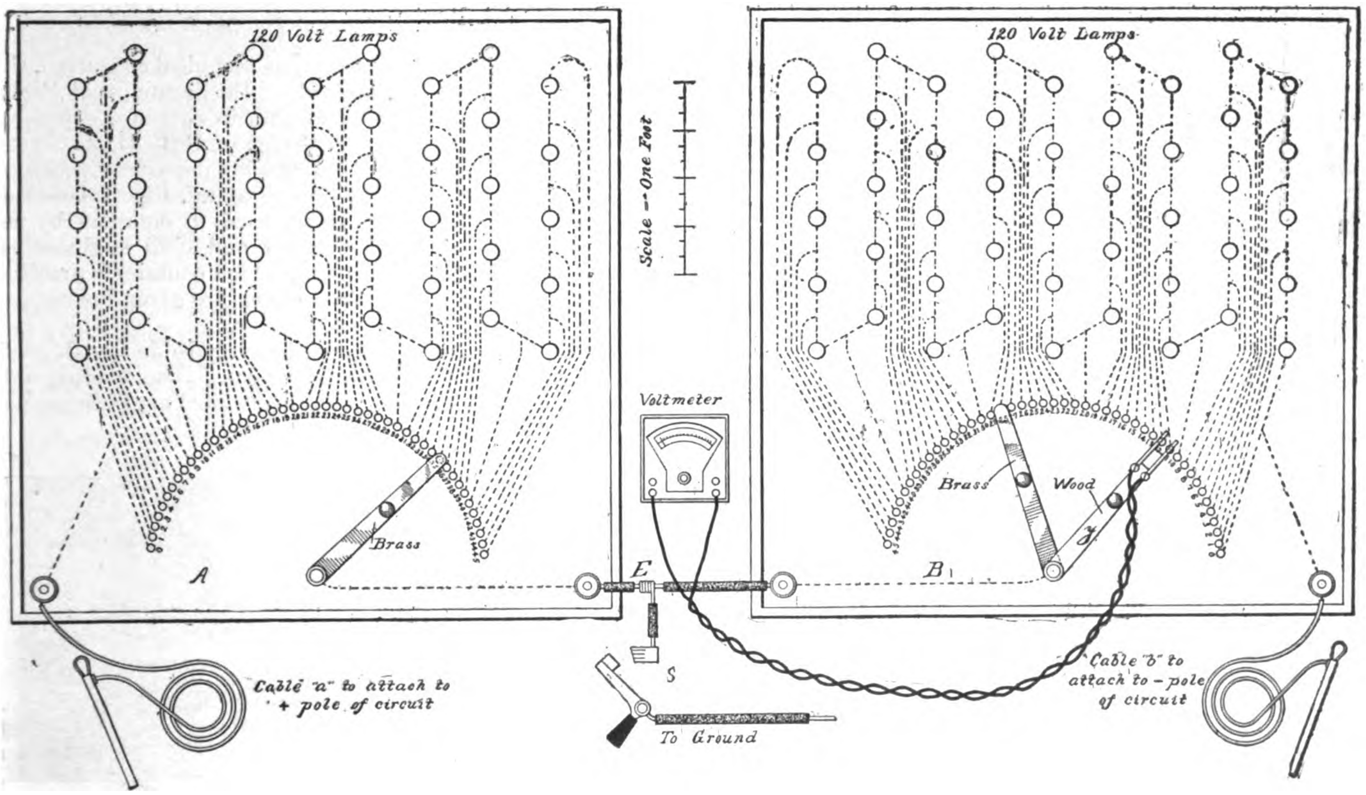


FIG. 1.—STARK'S CENTRAL STATION METHOD OF LOCATING GROUNDS ON ARC CIRCUITS.

take when run at 50 volts, the current being too small to be noticed when diverted from the arc lamp circuit. These banks or arms, A and B, are connected by a wire E which is attached to the switch S with its ground connection; to the other ends of the arms A and B are attached flexible cables *a* and *b* to connect to the circuit terminals under test.

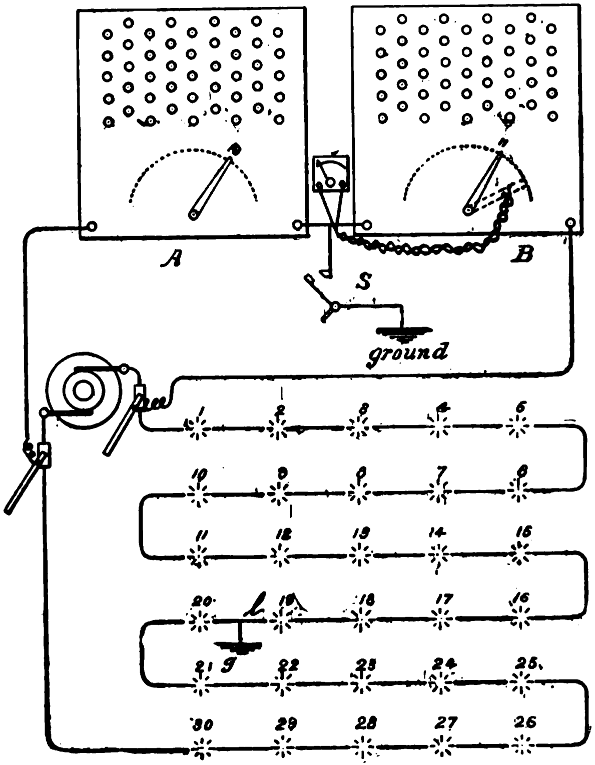


Fig. 2.—Locating Grounds on Arc Circuits.

On installing a set of lamps, each arm is to be calibrated. This is done by connecting cables *a* and *b* to the + and — ends of a circuit of, say, 80 arc lights; then with all the incandescent lamps in and the levers on lamp No. 45, the voltage of each lamp is measured by the use of the auxiliary switch *y* (which is arranged to be unbolted and attached to either board) and the voltmeter. Any lamp that is more than two volts from the average is discarded and a better one is put in its place. The average voltage is taken and a lamp selected that equals this average voltage and this lamp is used hereafter as the standard in computing voltages, etc.

Having the boards thus arranged, after the circuit has been started the cables *a* and *b* are attached to the circuit + and — terminals. All the incandescent lamps are cut in; that is, the levers are on segment No. 45 making 45 lamps of A and 45 lamps of B, or 90 lamps in all, in parallel with the outside arc lamp circuit. The ground switch is now opened and closed and the operator observes if there is any change in the brilliancy of the lamps in the arms A and B. If there is any change when the levers of A and B are in equal and then in largely unequal positions, on the opening and closing, respectively, of the ground switch S, it is indicative of a ground on the arc circuit.

Now comes the "bridge" part of the arrangement. A balance is obtained by altering the number of lamps in arm A or B, as required, so that upon opening and closing switch S there is no change in the voltage of the standard lamp, as indicated by the voltmeter. We have then this proportion: The number of lamps on of A is to the number of lamps on of B, as the number of arc lamps on the positive leg of the circuit to the unknown ground is to the number of lamps on the negative leg to the ground. Or A : B :: number of + lamps: number of — lamps. But if we alter A and B so that the voltage of the standard lamp is 50 (or equal to the voltage of the arc lamp on the circuit, if other than 50), then A equals the number of lamps on the positive leg, and B equals the number of lamps on the negative leg to the unknown ground; and A + B equals the lamp equivalent of the running circuit; A + B times 50 equals the voltage of the circuit.

Fig. 2 illustrates a case of an arc light circuit with a ground leak at *g* of *l* ohms resistance. The ground test bridge is applied as shown; cable *a* is on the positive pole and cable *b* is on the negative pole of the switchboard. The levers are placed each on No. 45 and the switch S is opened and closed; and the operator observes if any change in brilliancy is effected with the levers in this position of equality, or after moving one of them to, say, lamp No. 10.

In this case there would have been a change in brilliancy of the lamps during the first test. Then by altering A and B so that there is no change in the voltage of the standard lamp a balance is obtained and, as stated above, A : B :: the number of + lamps : the number of — lamps. Or, should we adjust A and B so that the voltage of the standard lamp is equal to the voltage of an arc lamp, then A = number of + lamps, and B = number of — lamps to the ground.

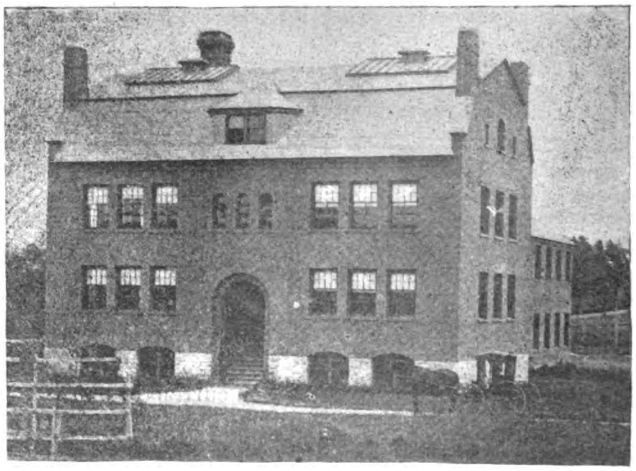
The voltmeter will detect a variation of less than ½ volt per lamp. The apparatus will locate between lamps a leak of over 40,000 ohms resistance on an 80-light circuit.

ELECTRICAL ENGINEERING AT THE UNIVERSITY OF VERMONT.

In keeping with the progress of technical education, the University of Vermont, located at Burlington, that State, has recently organized a department in electrical engineering which has been placed in charge of Prof. H. A. Storrs.

The main building of the engineering departments, which is shown in the accompanying engraving, Fig. 1, contains the recitation and drafting rooms used in common by the students of electrical, mechanical and civil engineering. At the rear will be seen a wing, which contains a machine shop and foundry where the students are given instruction in shop practice.

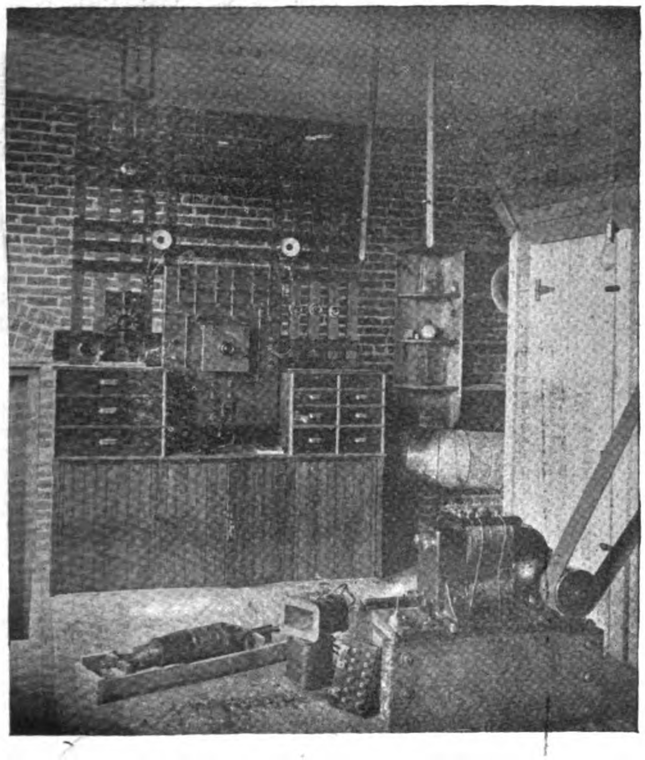
The work in electrical engineering is designed to fit students for practical electrical work. The leading subjects of study are mathematics, mechanical engineering and electricity; but some work in literature, history and modern languages is also required.



Engineering Building, University of Vermont.

In general, a student follows nearly the same line of study in electrical as in mechanical engineering, except that a part of the shop work and mechanical laboratory work is omitted to give place to special subjects in electrical engineering. These subjects, which begin with the Junior year, include the theory of potential, electrical measuring instruments, dynamo-electric machinery, etc., with laboratory work, such as comparative tests of batteries, efficiency tests of dynamos, etc.

Original investigations are permitted when deemed beneficial to the student, chiefly as an aid in the preparation of the graduating thesis. Technical essays, involving a study of different authorities and of the latest published articles, are frequently prepared by each student and presented for discussion in the class-room. The library is well supplied with electrical and other scientific papers, and with standard works in electricity.



Dynamo Room, University of Vermont.

The electrical equipment includes galvanometers of recent design for accurate work, sets of standard resistance coils, a Wheatstone bridge, Thomson's electrical balance of wide range, also his graded voltmeter and electrometer, besides much apparatus suitable for the use of the less experienced students. A dynamo, specially designed, and provided with extra armature and field coils, enables the student to learn by actual tests the relative merits of different types of direct current, arc and incandescent dynamos ; it generates electricity for the lamps which light the engineering building and shops, and for charging the secondary battery, as well as for tests of lamps, motors, etc. Sixty accumulators, mostly of the Julien type, and many varieties of primary batteries are available for experiments. An alternating current dynamo, with accessories, will shortly be added to the equipment, and among the more important accessions to the instruments are a Thomson large electrometer, graded voltmeter and composite balance.

The engraving Fig. 2 shows a corner of the engine-room where are placed a small dynamo designed more especially for experimental use, and the switchboard for controlling the lamps by which the building is lighted and for manipulating the storage batteries.

Up to the present time nine students have been enrolled in the electrical engineering course, which was opened at the beginning of the present year.

NEW DYNAMO OF THE DETROIT ELECTRICAL WORKS.

The accompanying engravings are two views of the new type of dynamo now being manufactured by the Detroit Electrical Works, and which on account of its many novel and valuable features deserves a detailed description. The type illustrated is that which has been adopted by the Detroit Electrical Works for all sizes up to, and including, the 30 kilowatt. As will be seen, the machine is of the two-pole ironclad type, in which the frame and bed-plate consist of one solid casting. Above 30 kilowatts the type will be similar to that illustrated, except that the machines will be multipolar.

The journal boxes are provided with self-centering and self-oiling sleeves, which insure perfect alignment and lubrication. Each bearing is provided with a gauge glass which shows the height of oil in the oil chamber, and with a cock by means of which the oil can be drawn off whenever desired. The lubrication of each of these bearings is accomplished by the use of two rings which revolve and carry oil to the top of the shaft, from which it is distributed by means of oil grooves in the self-centering sleeve. Directly over each of these rings, in the outer shell of the bearing, is a brass plug, which can be lifted out when it is desired to ascertain if the rings are working properly, or to put in new oil.

The rocker arm which supports the brush holders is mounted directly on the self-centering sleeve, thus insuring the brush-holders being kept central with regard to the commutator. Carbon brushes are used on all these machines, both for motors and generators. The brush holders are of a new type which provide just the tension requisite to make good contact of the brushes with the commutator without more tension than is required, consequently avoiding heating of the commutator by unnecessary friction. This tension is obtained by the use of a spring coiled in the form of an involute the outer end of which is continued straight from the side of the coil—which is below the brush holder—up to and a little above the outer ends of the carbon brushes. The idea is to have the tension due to the coil, when the straight end is in a perpendicular position, just sufficient to insure the proper contact; then, the coil of the spring, being mounted upon an adjustable axis which can be moved in or out at will, the commutator brushes near the spring can be moved inward, yet always maintaining its straight end in a perpendicular position. This insures at all times the same tension of the brush upon the commutator without changing the adjustment of the spring itself in any way whatever. This adjustment can be made at any time very easily by a single movement. As the carbon brushes feed radially they consequently wear squarely across their entire thickness and never require trimming.

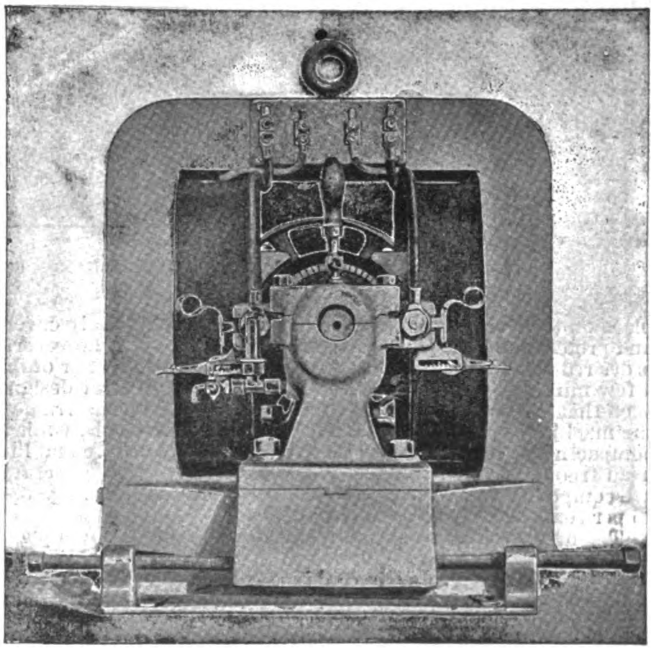


Fig. 1.—New Dynamo of the Detroit Electrical Works.

The two features of the lightest possible tension of the commutator brush on the commutator, and the use of the carbon brush, serve to lengthen greatly the life of the commutator, not only by reducing the wear but also by reducing the possibility of damage to either brush or commutator by sparking if the machine is overloaded, such as would naturally result from the use of copper brushes. This means a great saving in the matter of repairs, as the commutator is the most expensive part of a dynamo. The expense for brushes is also much reduced as carbon brushes not only cost much less than copper, but wear many times longer.

A case in point is the record made by a generator furnished by the Detroit Electrical Works to the Posselius Bros. Furniture Co., of Detroit, which machine, although one of the old type, was fitted with their improved brush holders and carbon commutator brushes. After sixteen months' use, every working day of which time the machine was running for a number of hours each evening, the original set of brushes furnished with the machine was still in use and not one-third worn out, while the commutator itself, although glazed by long use, showed no actual signs of wear when a straight edge was applied to it.

The armatures of all the new machines up to, and including, 30 kilowatt are of the drum type, but a special winding is used, which not only economizes space at the ends of the armature core and holds the wires at the ends in position firmly so they cannot chafe, but also has as its most important feature the advantage of having no two wires adjacent to each other that have between them any great difference of potential, thus doing away almost entirely with the probability of burn-outs. This winding also gives the largest opportunity for ventilation, and makes the danger of crosses at the end of armature as small as possible. The commutators of these dynamos are of a new design; mica is the sole insulating material used throughout in their construction.

The field coils are wound on metal spools and then slipped into place on the pole-pieces, where they are almost entirely covered and protected by the iron frame of the machine. If, however, it is desired to replace any coil with a new one it is a matter of only a few minutes' work to accomplish this. The general design is such that the armature is protected on all sides by the frame of the machine and the metal flanges of the field spools, while its compactness necessarily requires very small floor space and little head room for machines of their capacity. All generators are compound wound to give any desired increase in voltage up to 15 per cent. at full load.

The under side of the bed of each machine has grooves planed in it so that the machine can be mounted on slides for taking up slack in belt; or if it is desired to hold the dynamo in a fixed position, the lugs cast on the side of the bed-plate near the grooves can be used for bolting the machine down to its foundation. The dynamo shown has a motor headboard, which simply provides the necessary terminals for connections. On the headboards of the generators there is also provided in addition to these connections a double-pole quick-breaking head board switch, so that, when desired, the machine can be entirely disconnected from the mains, entirely independent of the switchboard appliances. These dynamos have a fixed point of commutation which renders possible the reversing of the machine and changing from no load to full load without any sparking whatever at the commutator. In designing this machine the advantages of slow speed have been kept in view, as well as the matter of efficiency.

The standard sizes of these dynamos now being made ar as follows, the ratings being in kilowatts: ⅛, ¾, 1½, 3, 5. 7½, 9 15, 20, 30, 40, 60, and 100. Larger machines of the multipolar type will soon be brought out.

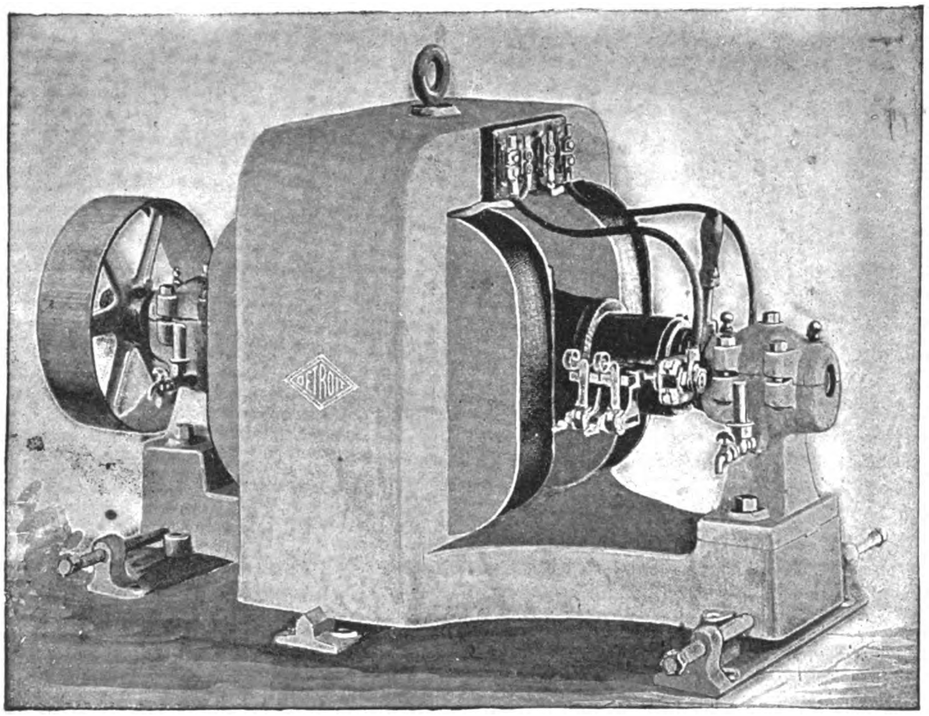


FIG. 2.—NEW DYNAMO OF THE DETROIT ELECTRICAL WORKS.

CENTRAL STATIONS.[1]

BY D. THOMSON.

IN time past when fabulous prices were obtained the profits were so great that a few extra pounds of coal consumed was not noticed, but now that competition has brought the prices of lighting to just barely living profits, it becomes imperative that the operations should be carried on in as economical a manner as possible if the shareholders are to receive any return for their money invested. The securing of such return is undoubtedly their right, and one that must be of foremost consideration in central station management, for without the capitalists, where would the electrical interests, both in manufacturing of apparatus and the supplying of current in its various forms, be to-day? To sum up then, just what a central station should consist of: The building should be one story high, built directly on the ground, with good and substantial walls of either brick or stone, set on well-footed foundations, with peaked roof and fan-lighted ventilators or windows running its entire length, the windows of which can be operated from the ground by means of levers. The material for the roof should be corrugated galvanized iron fastened to the beams and purlins, which are preferably made of angle iron, care being taken to see that the corrugated iron has some good fire-proof non-conducting lagging laid under it to prevent the condensation of the moisture contained in the warm air inside the building from coming in contact with the cold roof. A proper tower should be provided at one end, or the centre of the building, for the entrance of the necessary wires; markedly in contrast to the old plan of utilizing the woodwork on top of any window or door that might be the handiest to honey-comb with holes for that purpose. Proper stone and cement foundations should be provided for engines, shafting and dynamos, which must not have any connection with either the walls or the foundations of the building; the floor to be preferably of concrete with a rock asphalt top of at least ¾ of an inch in thickness, except where there are pipes and pits that cannot be well covered with other material than wood, on account of the necessity of being able to get at them at any time; such wood floor should be at least two inches in thickness, of good red pine, well seasoned, laid on good strong joists and beams, the beams being supported on brick or stone and cement piers suitably placed.

In the matter of engines, there can be no doubt that in stations of any considerable size (say, from 100 h. p. up) the most suitable for the purpose are what are known as cross connected twin engines of slow speed, and where water is available for condensing purposes, they are preferably built with high pressure cylinder on one side, and low pressure condensing on the other, though where the boilers are such that very high pressure can be carried (150 lbs. or more) it is a question whether results just as beneficial cannot be obtained by using a third cylinder, and a consequent triple expansion of the steam admitted at the first cylinder at such high pressure. There cannot be any doubt whatever that such engines can be operated at considerable saving over the best of high speed engines that are manufactured, and these high speed can only be recommended for isolated or small plants where slow running single engines would be apt to cause a fluctuation in the lights when passing their centres, which in high speed is entirely eradicated owing to their velocity. In the matter of boilers, there can be but one opinion where tests have been made, and that is in favor of water tube boilers, such as the Babcock & Wilcox, Crandell, Zell, or some other modification of them, for aside from the fact that they possess an element of safety that the ordinary return tubular boilers do not possess, they are quick and economical steamers and cost very little for maintenance.

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[1] Abstract of a paper read before the Canadian Electrical Association, Hamilton, June 15.

After the steam plant comes the belting, line shafting and pulleys, which for satisfactory working should all be of the best. The shafting should be fitted with self-oiling bearings, with oil reservoirs and ring feeders; said shafting and the necessary hangers or standards, should be constructed in such a way and of such material that they will be capable of standing a strain equal to at least 100 per cent. more than that which they will be ordinarily required to carry. The pulleys should be of the grip or clutch type, built so as to be able to carry at least double their ordinary load; such pulleys to be of such a design that if it should be necessary to stop one of the dynamos, both the pulley and the grip will stop together, and only the driving mechanism continue to revolve, thereby enabling the setting up of the grips or clutches on any one if required. This is the point that designers of central stations would do well to bear in mind. It has occurred in the writer's experience that where grip or clutch pulleys whose grips revolve with the shafting were used, it became necessary to stop an entire line of shafting together with engine to adjust one slipping clutch out of some four or five on the same line shaft, the pulley in that case being an elegant one in every particular but in this one point, that the clutch could not be stopped with the pulley.

To conclude, have your station fitted out with the best of dynamos and generators, and don't buy such apparatus simply because the price is low; in fact, cheap machinery is generally the dearest in the end. Let your switchboards be models of completeness and have them kept so continually. Bear in mind that they are your distribution points, and that if they fail you, your entire plant will be jeopardized. Have your lines and circuits equipped with good and efficient lightning arresters so that danger from this source will be a nullity. Make this part of your plant such that it can easily be got at, and if an arc should be caused through any means, have the necessary appliances at hand to break it as quickly as possible; one of the best things for such purpose is a bucket full of dry sand. Last, but not least, let your station be a model of cleanliness and neatness; have a place for everything and see that everything is kept in its place.

MAGNETIC PROPERTIES OF ALUMINUM-IRON.[1]

BY C. EICKEMEYER.

A PRELIMINARY test showed that the magnetic properties of aluminum-iron differ so little from those of ordinary cast iron that it was necessary, in order to determine any difference whatever, to reduce the castings to standard size. The test was made by balancing the aluminum-iron with a test piece of Norway iron, the magnetic characteristic of which is known.

The Al-iron was not compared directly with the standard Norway iron, but to reach a greater exactness in determining the difference between ordinary cast iron and the samples of Al-iron, first, a sample of ordinarily good cast iron was tested by comparing it with the standard Norway iron, thereby determining its magnetic characteristics. The Al-iron was then compared with this sample of ordinary cast iron and the difference between both determined.

This method eliminates the influence of remanent magnetism, to a greater part in the comparative tests, thereby increasing the accuracy and also serving as a check upon the work, since the piece of ordinary cast iron had been tested before. In the comparisons made, the piece containing the smaller percentage of aluminum proved to be superior to the one containing the larger percentage of aluminum in the cast iron. From which we can state that the addition of aluminum has no very marked influence upon the magnetic conductivity of cast iron, but slightly decreases its permeability.

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[1] Abstract from the Cornell *Crank*.

ELECTRIC RAILWAY MOTOR TESTS AT MINNEAPOLIS.[1]

BY PROF. GEO. D. SHEPARDSON AND EDWARD P. BURCH.

THE experiments here discussed were undertaken for the purpose of obtaining definite information about the performance of electric railway motors under various conditions. There is a diversity of opinion about the relative merits of regulation by rheostat and by commutated fields, the use of one or two motors on a car, value of wetting rails, causes of "bucking" and other points. It is commonly understood that electric roads using rheostat regulation require larger capacity at the generating station than those using the commutated fields. It is also known that one large road has substituted rheostat regulation for commutated fields on all its motors. One large road has effected marked reduction in the motor repair account by reducing the pressure on the lines considerably below 500 volts, this however being also accompanied by better instruction of the drivers.

Much has been said and written, but the data published are meagre and in some cases misleading. It was therefore thought desirable to obtain data from careful tests under working conditions in the hope of substantiating some of the claims made, and of bringing out some new facts. The tests were conducted for the most part by Mr. Edward P. Burch, a senior in electrical engineering in the University of Minnesota, in connection with his graduating thesis, and by courtesy of the Minneapolis Street Railway Company, especially the master mechanic, Mr. William Cooper. Most of the tests were made upon a No. 6 Sprague double-reduction motor of the type described by Mr. H. F. Parshall before the Institute May 21, 1890, and April 19, 1892. Some experiments were also made upon a single-reduction motor. Each machine is used at the repair shop for testing armatures, being anchored to a heavy crib sunk eight feet into the ground. Each car axle is replaced by a short shaft carrying a heavy cast-iron wheel with solid web, upon which two oaken blocks are bolted for use as a brake. This was made into a Prony brake by removing the angle irons that held it to the floor and bolting on a plank to which an iron plate was fastened, so as to give a knife-edge bearing at a distance of 63.1 inches from the centre of the shaft. This plate rested upon a knife-edge supported upon platform scales by which the turning moment could be measured. The mechanical horse power delivered at the car wheel is

$$\text{H. P.} = \frac{2\,\pi\,R\,P\,N}{33,000} = \frac{P\,N}{1,000},$$

in which P is the pressure on the scales, N the revolutions of the car axle per minute. The speed was measured by a common speed indicator with soft-rubber tip to prevent slipping. For slow speeds a stop-watch was used, the time for five revolutions of the car wheel being noted. Current and potential were measured by new Weston instruments, about 12 feet distant from the motor.

The Sprague motor armature has 56 sections of eight turns each of No. 12 B. and S. G. wires. The speed is reduced 11.765. The field coil as used at first was in three sections, coil A of 700 turns, coil B of 820 turns, and coil C of 620 turns, all being No. 12 B and S. G. wire. By means of the well-known barrel switch these coils are thrown into the following combinations:

Clip 2, Coils A, B and C in series.
Clip 3, Coils A and B in series.
Clip 4, Coils A and B in parallel, C in series.
Clip 5, Coils A and B in parallel.
Clip 7, Coils A, B and C in parallel.

Several sets of efficiency tests were made with each combination. The three pairs of coils were then replaced by a single pair of coils connected in series and having several terminals so that the number of turns used might be altered. This was used in connection with a Thomson-Houston rheostat. Efficiency tests were made with and without the rheostat. Only a few of the tests and curves obtained can be given in this paper. In comparing these curves among themselves and with the result of other experimenters, it should be noticed that the voltage was considerably below that for which the motors were designed, and that the power delivered was measured at the car axle. Different armatures were used on different days, and the curves in different plates are not strictly comparable; but the curves given in any one plate were taken with the same armature and with approximately the same voltage. Each of these armatures had been recently repaired and although they had been well baked there may have been some leakage through the green shellac. The Foucault currents in the cores were probably greater than in new armatures. With the same armature and fields the efficiency is a few per cent. higher cold than when hot. It has been the aim to run as nearly as possible at the temperature of ordinary running, so that the fields were comfortably warm but not hot. It is confidently believed that the efficiency of these machines would be considerably above 90 per cent. if taken at armature shaft and with full voltage.

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[1] A paper read at the general meeting of the American Institute of Electrical Engineers, Chicago, June 6, 7 and 8.

Fig. 1 shows efficiency curves for the motor with different combinations of the field coils.

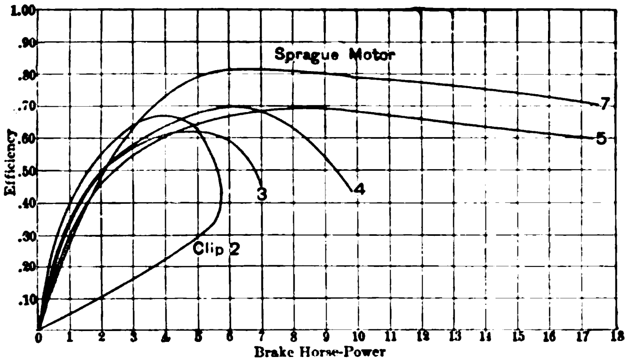

FIG. 1.

In Fig. 3, curves A and B show efficiency of the machine with 857 and 611 turns of No. 7 wire in the field coils. It will be noted in Figs. 1 and 3, that the motor has highest efficiency with the larger number of turns on field coils until the iron is saturated, when the better efficiency is given with smaller number of turns and consequent lower resistance in field. This shows the advantage of working on the fifth and seventh clips with barrel regulator, or of cutting out part of the turns on field when the load is heavy. On starting the car, the current is very heavy and the field is saturated with a small number of turns; hence the torque with a given current is nearly the same whatever the windings of the field. The speed and counter E. M. F. are small at starting; hence the potential difference at the armature brushes should be reduced until it passes only enough current to start the car without jerking. The easiest way of reducing the potential difference at the brushes is by interposing resistance; and the heat developed by the C² R can be cared for more easily and cheaply in an open rheostat than in the field coils. Rheostats of iron and mica are cheaper and more heat-proof than cotton-covered wires. This forces the conclusion that for the heavy load due to accelerating the car at starting, the field should have the smaller number of turns, and as the car reaches normal speed, and the H. P. and C become less, the efficiency of the motor would be raised by increasing the number of turns in the field. This conclusion is exactly the reverse of the common practice of manufacturers who sacrifice some efficiency for speed at small horse powers. It is also in line with the experience of the road mentioned, that replaced the commutated fields with a single series coil of No. 7 wire, and later with No. 5 wire. This heat-loss could be saved and the average efficiency raised, by using the two motors in series at the start, and afterwards cutting out one or putting the two motors in parallel, if necessary, as the speed increases and H. P. decreases. An average of 12 tests on the road shows that with two motors on a car, it requires 27 per cent. less current if only one is working.

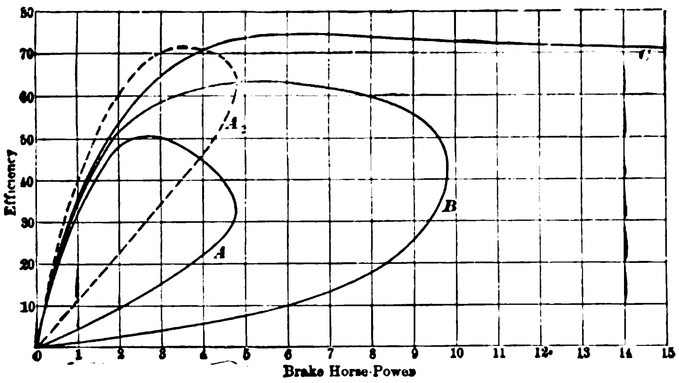

FIG. 2.

In Fig. 2, curve A shows the efficiency of Sprague motor with single pair of coils, when the whole of a Thomson-Houston rheostat is in circuit. B shows about ½ of the rheostat in use; and in C it is all out. The dotted line A_2 gives the efficiency as calculated from the difference of potential about the motor alone. Curve A_2 is not strictly comparable with the others on account of the necessary variations in the voltage at the motor; but it does show the increased efficiency to be obtained by utilizing the superfluous voltage in a second motor in series. In this connection it is interesting to note that the resistance of a rheostat as calculated from current and potential difference, decreases with increase of current. This is as expected, since the larger part of the resistance is due to surface contact between the plates of iron in the rheostat, these being pressed together more closely as the iron heats. A similar effect but much more marked has been noticed in earlier experiments by one of us, with alternate plates of carbon and iron.

Figs. 4, 5 and 6 show curves of torque, speed and horse power, referring to the No. 6 Sprague motor. In Fig. 5, A shows horse power and horizontal effort on a 30-inch wheel; B, C, D, E and F, clips 2, 3, 4, 5 and 7, respectively. In Fig. 6, A shows speed and horse power, with all of the rheostat in; E with ½ of rheostat in; B, C, D, F and G, clips 2, 3, 4, 5 and 7, respectively. These may be compared with results presented by Prof. S. H. Short before the Chicago Electric Club, March 28, 1892. Fig. 7 gives curves of current, torque, speed and efficiency from a 15 h. p. Thomson-Houston single-reduction motor. The reduction ratio is 4.7857.

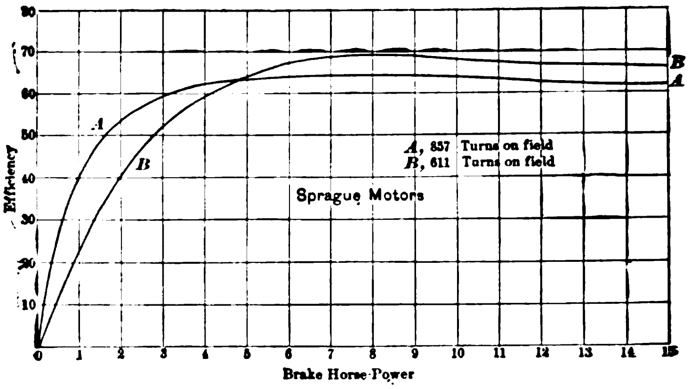

FIG. 3.

A large number of running tests were made on cars in regular service. Fig. 8 shows a run on the Interurban line between Minneapolis and St. Paul. The distance is about ten miles, the schedule time 55 minutes, cars equipped with two 25 h. p. single-reduction motors. Special trains sometimes make this trip in 30 minutes or less. Fig. 9 shows three runs on the University line of Minneapolis on successive days, with the same car and same driver. The lower curve was taken when the rails were dry and dusty, middle curve with wet rails, and upper curve when the ground was covered with snow, eight inches deep on the level. The snow-plow had been over a part of the track about an hour before. The curves show variation of time, number of passengers being noted.

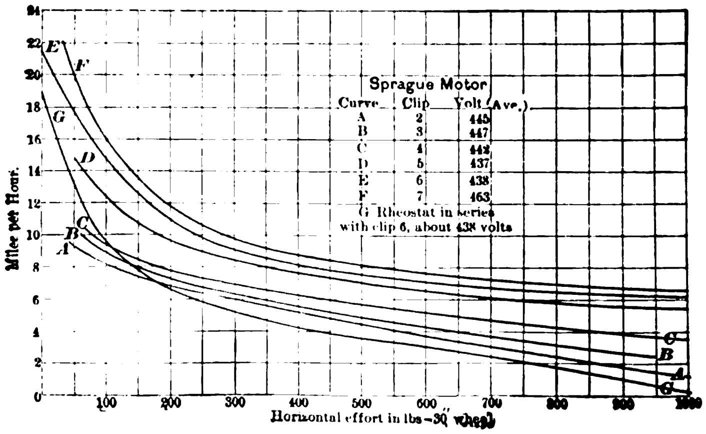

FIG. 4.

It will be noted that the current was less with wet rails although there were more passengers. The load at the station is about the same for a rainy day as for dry, the difference being probably made up by the increased leakage on the lines, and by the larger number of passengers on some cars.

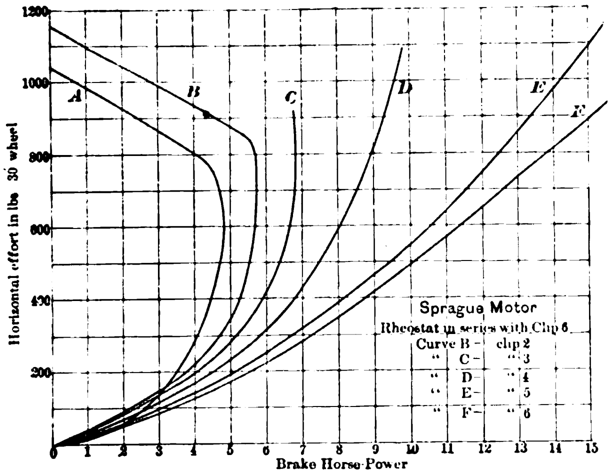

Fig. 5.

	Feb. 5.	Feb. 6	Feb 7.
Condition of track...............	Dry.	Wet.	Snowy.
Number of stops......	38	50	36
Average voltage......	445	450	440
Average amperes.....	15.15	14.9	17.5
Average amperes while working.....	23.4	20.9	28.1

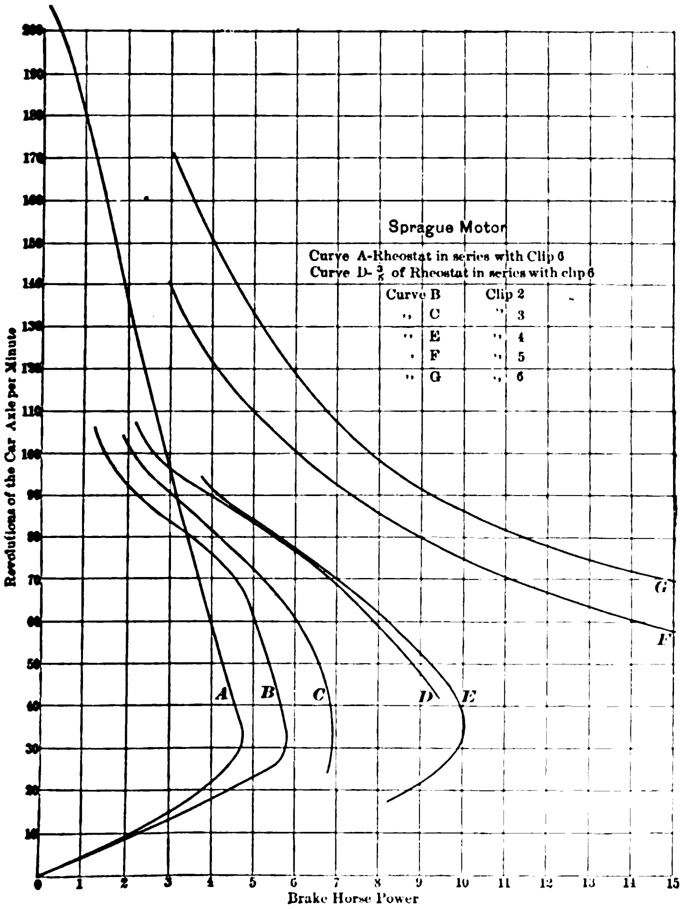

Fig. 6.

Fig. 9 shows variation of current on a single car. Fig. 10 shows variation of current on a feeder to line with five cars, the average current being about 60 amperes. Fig. 10 is plotted from readings taken at intervals of two seconds. The ammeter stops some little time at the high and low points, showing that these are actual values of the current and not due to the inertia of the ammeter.

Fig. 11 gives the results of readings one second apart taken on the main ammeters in Minneapolis and St. Paul and on one feeder in Minneapolis. There were about 190 cars on the Minneapolis line, 100 on St. Paul lines, and 32 on the one feeder.

The wide fluctuation of current from 1,400 to 2,600 amperes within a half minute is remarkable, since it is generally supposed that the load is more uniform on a road with so many cars. Continued observation of the main ammeter (but without record) indicates that fluctuations nearly if not quite as great as that shown in the curve, occur several times an hour. It emphasizes the desirability of heavy fly-wheels in railroad power houses and also explains why in some cases the electrical output was largely in excess of the mechanical horse power as calculated from the indicator cards taken at the same instant.

Fig. 12 gives the daily load of the Minneapolis power house, the curves being plotted from readings of the ammeters taken at ten-minute intervals throughout the day. In this case the power units are unusually large, there being two triple-expansion condensing Corliss engines, the constant loss from friction in engines, shafting and dynamos averaging 218 h. p. Indicator cards were taken simultaneously by means of electromagnetic attachments on each of the twelve indicators, the same current also giving signals to the observers at the ammeters.

A series of thirteen tests were made for ascertaining the effect of wetting or greasing the rails on a curve. Two cars were coupled by a spring dynamometer and the pull noted while rounding the curve at ordinary speed which was kept nearly uniform by means of a brake on the motor car. The average pull on dynamometer is as follows:

	Dry.	Wet.	Greased.
Outer track.....	500–800 lbs.	400 lbs.	800 lbs.
Inner track.....	650 "		400 "

The inner rail was wet or greased in each case; but on the inner track the greasing was not so thorough on account of the lateness of the hour. It is noticed that wetting the rail reduces the power required about one-third, and greasing reduces it one-half. Readings of the ammeters on the car correspond in general with the dynamometer readings.

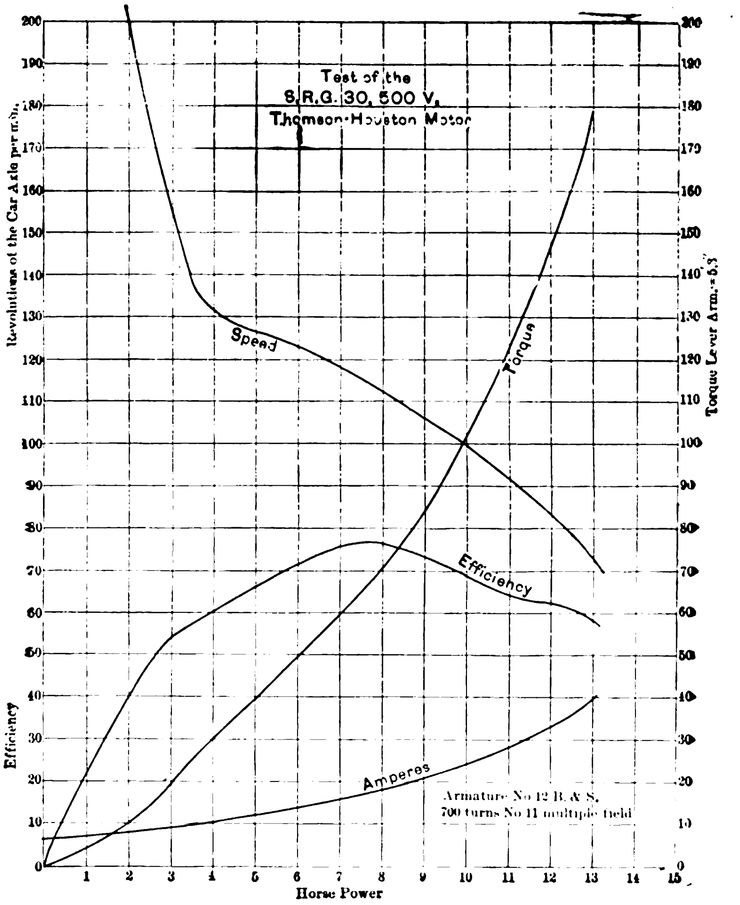

Fig. 7.

The "bucking" of street car motors is a subject of considerable interest to street railroad men although it seems never to have been discussed in public. From the silence of the books and papers, and from the ideas current among railroad employees, the conclusion is reached that little is known about its conditions, causes or remedy. It is therefore thought wise to present the results of observation and tests, with a theory for the cause and remedy. It sometimes happens that an electric car suddenly stops as if by collision. In some cases the car refuses to go further, but usually it goes ahead immediately as if nothing had happened. This is known among railroad men as "bucking." To explain the action it is noted that in common practice the motor fields are connected between the armature and trolley, the armature being grounded at the negative brush. If a second ground occurs on any part of the machine except between the fields and trolley, a heavy current passes to ground giving an intensely strong field while the armature is short-circuited by reason of the two ground connections. It therefore acts as a dynamo on short circuit, and becomes a powerful electric brake that stops the car very suddenly. This agrees with the facts, since a second ground either from loose connecting wires or broken insulation always causes bucking. Evidently if the ground occurs entirely outside of the machine no bucking follows, since the series motor cannot excite its own fields, and act as a dynamo unless the armature connections are reversed. It is common practice to connect the two motors together between the fields and armature to equalize the work of the two machines. When a ground occurs in such a case, both armatures act as brakes and the bucking is more violent than when the "equalizer" connection is not used. A loose reversing switch has been known to reverse the motors accidentally and spasmodically. There are many cases of bucking where no evidence of a second ground can be found. Doubtless some of these may be accounted for by temporary ground which burns itself out—a common method of

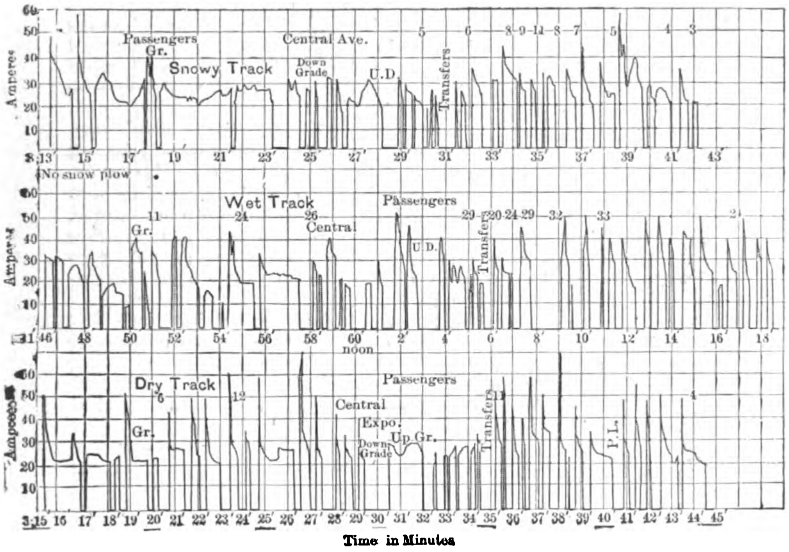

FIG. 9.

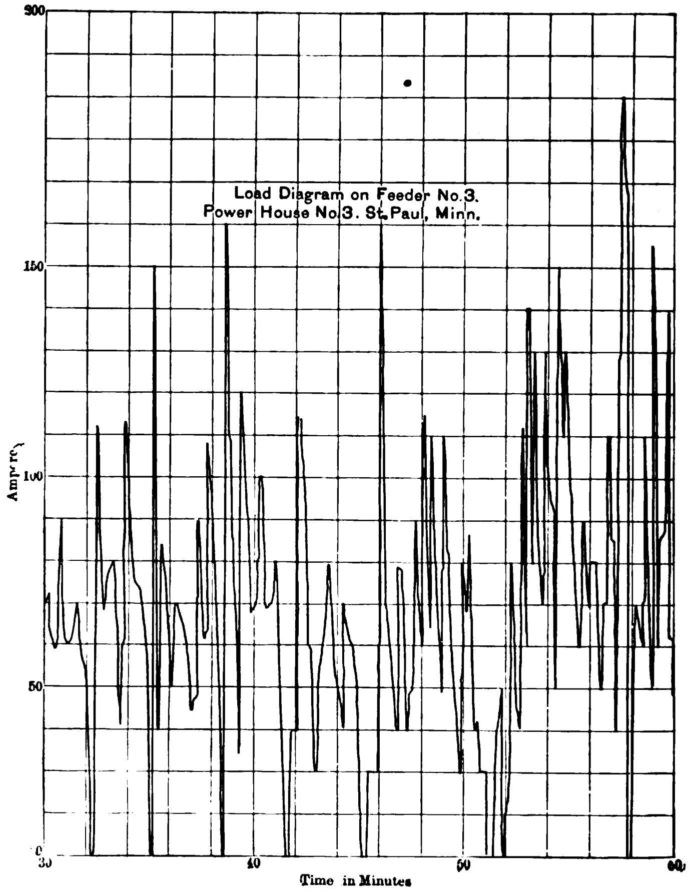

FIG. 10.

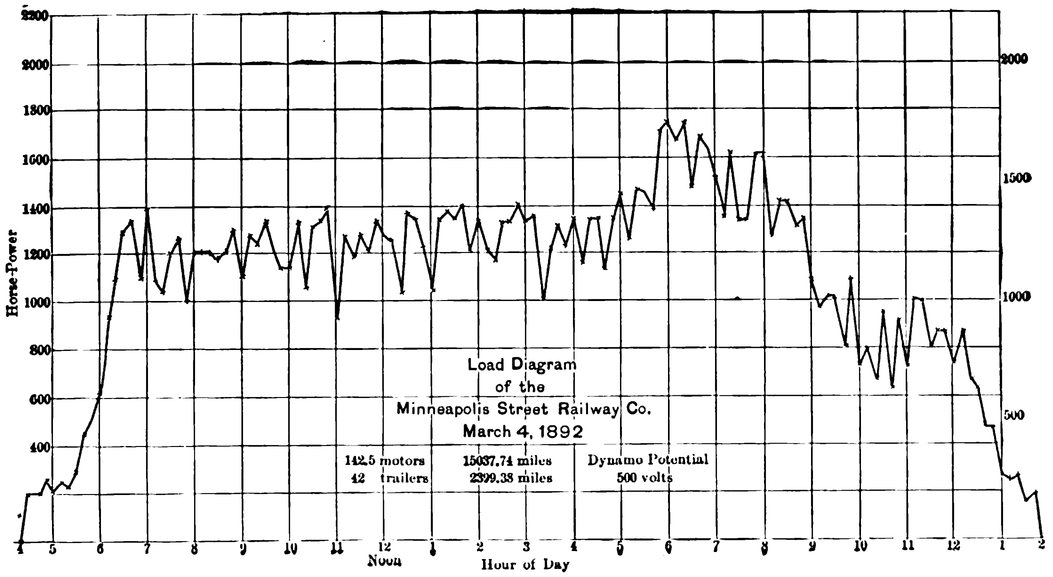

FIG. 11.

removing grounds and crosses. This explanation will not hold in many cases. Extended inquiry was therefore made among railroad men in order to gather as many facts as possible. Some of these reports were incredible at first, but seem to be honest testimony and were afterward corroborated by others.

It may be well to state that the term "bucking" is used with some looseness, being sometimes applied to cases where a motor acts badly for a variety of reasons, but as used in this article it is to be taken in the sense above noted. There is a tradition among the car drivers that a motor is very liable to buck if the current is full on while running down hill, but no case of this sort could be substantiated. Cases are reported of a motor bucking when the circuit is opened for an instant, as may be caused by the trolley jumping off and on, or by the car passing over a dead rail or over a very dirty track. It is not plain that this is a true case of bucking, but rather of a sudden cessation and re-application of the propelling force.

Sometimes a car will buck at regular intervals. Examination of the motor shows a small bright spot on one brush which rolls to and fro at the contact between brush and commutator. This is intensely bright like a ball of melted metal and grows larger until nearly three-fourths of an inch in diameter, when it suddenly explodes with considerable noise and a blinding flash, and at the same instant the motor "bucks." The car goes on again at once, and the cycle is repeated again in the time required to run from one-half to four city blocks at ordinary speed. In such a case the bucking is stopped by shifting the brushes.

One case is reported where a motor bucked hard although the brushes were removed so that the armature was entirely disconnected. Here the field was charged by being in parallel with the field of the other motor, and a cross in the armature coils short-circuited it. The foreman of the repair shop where our efficiency tests were made, states that on six or eight occasions he has seen a motor buck because the carbons were not properly placed in the holders. In testing armatures rapidly, the carbons are sometimes placed carelessly so that the presser-foot rests partly on the carbon and partly on the holder. This presses the carbons against the commutator so as to give good contact until the carbon wears off a little, when the presser-foot no longer feeds it in. Vigorous flashing occurs, culminating in a buck, the shock of which may jar the presser-foot into its proper position, when the motor runs on as if nothing had happened, leaving behind no trace to indicate cause of trouble.

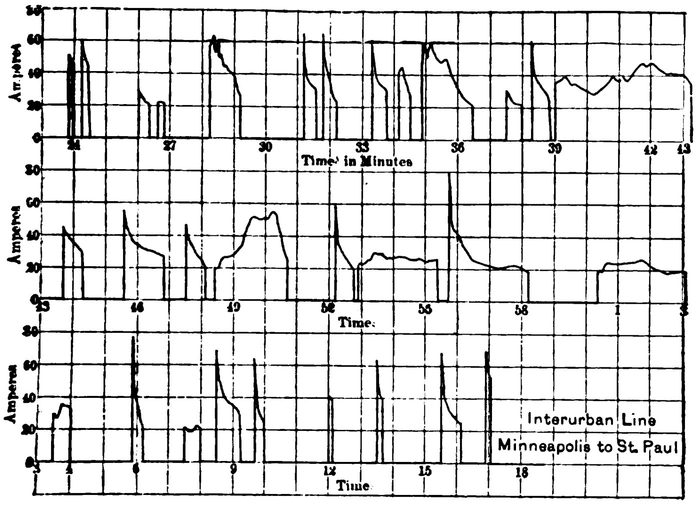

FIG. 8.

Cases have been reported where a wire on the track touched the motor as it passed, thereby grounding it and causing it to buck. Similar grounding may be caused by water or mud being thrown upon certain parts of the motor.

The motors with Gramme ring armatures are known to buck more frequently than those with drum armatures. These buck worse when run on the "loop," *i. e.*, with part of the field coils cut out, some of them bucking regularly every time the loop is cut out. This is one reason why the use of the loop has been abandoned on this road except in a few cases. The machines with commutated fields would buck when the field coils became old, although they showed no signs of being grounded. Bucking became much less frequent when the commutated fields were replaced by a single pair of series coils.

It was noticed that bucking was very commonly preceded by flashing at the brushes, although flashing was not always followed by bucking.

The explanations offered are various. One is that the iron in the fields varies in magnetic quality so that one motor works harder and by some means acts upon the other as a dynamo. Another is that one motor becomes reversed while the other does not. Another is that bucking is caused by poor brushes or brush holders.

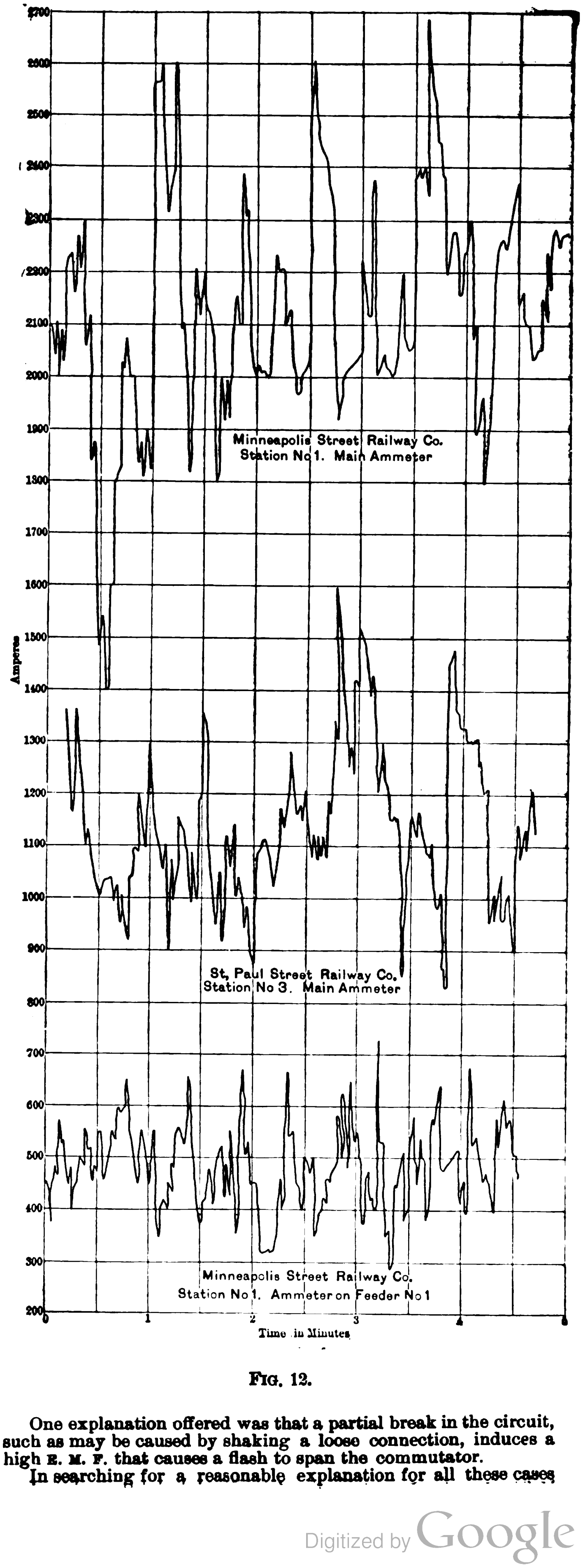

FIG. 12.

One explanation offered was that a partial break in the circuit, such as may be caused by shaking a loose connection, induces a high E. M. F. that causes a flash to span the commutator.

In searching for a reasonable explanation for all these cases in which no second ground connection existed, it was noticed in each case that bucking was more liable to occur when the field was comparatively weak; also where the armature reaction was greater. In each case the neutral line is shifted and the coils under the brushes are in an active field. The large current in short-circuited coils further distorts the field, and the sparking at brush becomes excessive, causing a vigorous flashing. As soon as the counter E. M. F. in the sections leaving the brushes rises above 20 volts, the arc is carried around from one brush to the other, thus grounding the positive brush and short-circuiting the armature, which then acts as a dynamo and causes the motor to buck. Such bucking is usually less vigorous than when caused by a dead ground, on account of the resistance of the arc. This explanation covers all the cases noted.

Such being the causes of bucking the remedies are plain. Armature reaction must be reduced. This militates against the conclusion drawn by Mr. Parshall, in his recent Institute paper, that the strength of field is of little importance, and that the windings of the armature should be a maximum. The liability to bucking would be reduced even when there is a large armature reaction, if the armature is divided into a large number of sections.

An obvious remedy for bucking caused by direct grounding would be to connect the fields between armature and ground instead of between armature and trolley. With such an arrangement, a ground on the fields would simply cut out a part of the coils and cause that machine to work harder. A ground at brush between armature and field would cause a sudden forward impulse on account of the field requiring some time to lose its magnetism, and would blow the fuse. A ground on armature would likewise cause a sudden forward impulse and blow the fuse. With such an arrangement there would be no true bucking except in case of the flashing as noted. An incidental advantage of this arrangement is that the difference of potential between the field and the frame of the machine is reduced to a few volts caused by the drop through the field; hence there is less danger of grounding the field. The increased difference of potential between armature and core is only a few volts and would not affect the insulation very much.

INSULATION.[1]

BY THOMAS A. EDISON.

TO telegraphy the insulation of the circuits is so vital a matter that at the risk of making history repeat itself, and of recounting an oft-told tale, a short paper on the subject may be tolerated.

As a class, gases are the best insulators; next liquids, and solids last of all. The insulation of gases is so good that no determination appears yet to have been made of any leakage through them. If it were possible to make an experiment at or near the centre of the earth, so as to be beyond the reach of gravitational force, an electrified body might be left for hours in a gas without any visible means of support, and observations then made to determine whether any loss of charge took place through surrounding gases. Under existing circumstances, the loss of charge which always does take place on electrified bodies, cannot readily be traced beyond that through the suspension or support that holds them. Even in moist air the loss of charge has not yet been brought home to the aqueous vapor. Professor Boys exhibited before the Physical Society of London in April, 1889, a pair of electrified gold leaves, suspended in moist air by a short hook of quartz. The loss of charge appeared to be about 25 per cent. in five hours. A glass hook, under the same conditions, would have allowed the charge to disappear, it was said, within one minute.

If any perfectly insulating solid could be found, telegraphists would soon discover any surface leakage from their wires through the air, for the surface of a No. 8 B. & S. wire is 224 square feet, or 20.8 square metres per mile.

The loss of charge which takes place convectively into the air over any sharp point in an electrified body, is a phenomenon of a different nature. There the layer of atmosphere over the point is continually being torn by the magnitude of the forces brought locally to bear upon it, and the particles of moving air carry away the charge.

Some liquids have also a very high insulation, notably most mineral oils. Animal and vegetable oils are by no means so good, or, at least, there is greater diffculty in obtaining them in a highly insulating condition. Water, contrary to prevailing notions, is quite an insulator. In the purest distilled water, resistance as high as seven megohms per cubic centimetre have been recorded; that is to say, a block one centimetre cube of water pressed between two opposite conducting plates as electrodes, would offer a resistance of seven megohms; but the least trace of impurity brings the resistance down.

Ice at —12° C. has been measured at 2,240 megohms per cubic centimetre. There are two conditions of surface upon which bare wires miles in length, laid on the ground, have been worked telegraphically—one over the dry desert sands of Africa, the other over dry ice in the far north. Sea water has a resistance of about 30 ohms per cubic centimetre at 5° C. It would appear probable that liquids cannot conduct without electrolytic decomposition. A microscope will show that one microampere decomposes the drop of water it traverses.

One of the most important and promising modern theories of chemistry is based upon the assumption, in accordance with a considerable array of facts, that solutions only conduct by the transfer of atoms or ions to the electrodes, each carrying an electric charge, and the conductivity of a liquid measures on this hypothesis the number of uncombined or dissociated ions permeating its mass. These free ions are the porters carrying the charge, and the conductivity of the liquid depends upon the number available and the speed with which they can migrate.

Liquids, too, have, as a class, the quality of elastic insulation to high tensions, which is an important feature to the electrical engineer. Air for the first few centimetres will break and allow a spark discharge to occur when the pressure reaches from 10,000 to 50,000 volts per centimetre (25,400 to 127,000 volts per inch) according to the shape and condition of the electrodes, but rosin oil is said to stand about 75 times the pressure of air per centimetre without disrupting.

The following is a list of actually observed resistance in commercial samples of well-known insulating substances. The results are given in megohms per cubic centimetre at or near 18° C.:

Paraffine wax	110,000,000	megohms.
Heavy paraffine oil	8,000,000	"
Olive oil	1,000,000	"
Lard oil	350,000	"
Creosote	5.4	"
Stearic acid	350,000,000	"
Sperm oil	0.077	"
Benzine	14,400,000	"
Balsam copaiba	211,000	"
Benzole	1,320	"
Oil of wood tar	1,670,000,000	"
Crude ozokerite	450,000,000	"

All transparent solids are insulators, but of course the opposite statement is not true that all opaque solids are good conductors. There is now good evidence for believing that the process by which light is propagated, the mechanism by which it is transmitted through space, is purely electromagnetic, and the magnetic vibrations passing through a conductor would generate electrical currents and be absorbed in the substance as heat, that is to say, it would be opaque to the light, failing to transmit the energy.

The difficulty with solids is not so much to find insulators, for the great majority of solid substances freed from moisture are poor conductors, but to find an insulation of suitable mechanical qualities. Glass, porcelain and mica seem to be almost the only practically available insulators that will support considerable stresses and these for many structural purposes are far weaker than is desired. In American telegraphy, glass is almost the universal insulator, but in Europe, particularly in the south and west, the atmosphere is so much more humid, and glass so hygroscopic, that no circuit of any length could be operated with glass insulators except in dry weather. Porcelain or vitrified stoneware insulators are used instead, and in quite a variety of forms. Practically speaking, the insulation of a line is never that of the material forming the insulators, but always that of their surfaces, and the films of dust and moisture that may have become encrusted thereon. The most perfect insulators are those which have underneath the hood a cup filled with oil, in such a manner that the current leaking from the wire to the ground has to pass over the oil, or else through the substance of the insulator itself. These insulators are certainly more expensive, and require to be refilled with oil at intervals, but they will defy weather and keep the insulation nearly as high in fog as in sunshine.

When a long, leaky wire is opened at the distant end, and tested for insulation, the insulation per mile always appears to be somewhat more than it is for any actual mile, since the more distant portions of the line are tested with a reduced pressure owing to the leakage over the nearer portion. When the wire is grounded at the far end, and its conductor resistance measured, the leakage will on the other hand make the apparent resistance per mile too low. But if the conductor resistance is reduced in a given ratio, say as 100 to 95, the insulation will be overindicated in the exact inverse ratio of 95 to 100, provided that the insulation of the line is uniform. So that if a wire's conductor resistance at its temperature of observation is known to be 10 ohms per mile, but appears by leakage over the whole length to be 9 ohms, then if the insulation per mile apparently measures 400,000 ohms, it will be really 360,000, and each mile taken separately might be expected to measure 360,000. As is well known, telegraph lines work better up to a certain point if the insulation is rather low. A wire has to be emptied of its charge between the impulses of the key sufficiently far to keep the relays from sticking. If the insulation is perfect, this quantity has to be cleared through the ends to the ground, but if the line leaks it can escape more readily at all points.

The longer the line, the more essential good insulation necessarily becomes. The insulators are perhaps never more carefully tested than those intended for the long circuits on the Asiatic plains. It was at one time customary to test each insulator before it went out, by taste. The insulator was immersed nearly to the rim, head downwards in the water, and a battery of 100 cells was connected with one pole to the water and the other to the insulator stalk through a particular kind of key. The operator first rested his moistened finger on this key and then applied his tongue to it. If he tasted no current, the insulator was passed out as satisfactory. The test was sensitive and expeditious, and saved the care and handling of a galvanometer.

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[1] A paper read before the Railway Telegraph Superintendents' Association, Denver, Col., June 15 and 16.

The insulation of a wire is a definite term and stands for a definite property so long as it is not necessary to measure it very accurately. There is usually no difficulty in finding the insulation of any overhead wire within 5 per cent. at any one time, and two observers measuring the line from the same end with different instruments would generally agree in their results to that limit; but as higher degrees of accuracy are attempted (a condition that fortunately does not practically occur) the difficulty of obtaining concordant results may increase rapidly. A resistance coil of wire at a uniform temperature can have its resistance measured to within one-fiftieth of one per cent. if necessary, but a leakage resistance is essentially liable to variation. The atmospheric conditions may be altering, or there may be polarization, or inductive disturbances from neighboring wires, or a combination of conditions that may set close measurement at defiance. It is generally advisable to employ galvanometers for this purpose, that even if sensitive, are slow of movement and dead beat. The only instances in which accurate measurements of installation are possible and necessary, are in connection with subterranean or sub-aqueous wires. Jute and paper, dry or saturated with compound, are rapidly coming into use for subterranean wires sheathed in lead, while for long cables under water, india-rubber and gutta-percha are invariably employed. With conductors highly insulated by these methods, the insulation can be measured much more closely, and is definite for a given temperature of the core, but even in this case the current that will flow from a battery into the wire freed at the distant end is not all leakage. A considerable portion may be stored up in the insulating substance, and be returned from the wire to ground after the battery has been removed. This "polarization" is particularly noticeable with gutta-percha and india-rubber covered wires, and their insulation may be apparently 50 per cent. greater after three minutes of charging than at the end of the first minute. In specifications it is usual to call for a certain insulation per mile at 75° C., and after a definite interval of charge.

The insulation obtained from a given thickness of covering depends on the diameter of the wire as well as on the quality of the cover, for a large wire supplies a larger leaking surface. Also if an insulating coating of a certain thickness produces an insulation of 100 megohms per mile, doubling that thickness will not double the insulation because the leakage will take place with greater relative facility through the greater surface of the second coat. The exact increase of insulation will depend upon the diameters of first coating and wire.

When a wire is well and homogeneously insulated, its insulation resistance at a given duration of charge or period of electrification will appear to be the same with different battery powers or voltages applied, but if, on the contrary, it contains any small faults or defects, it will generally show less insulation with increasing testing pressures. This often forms a criterion as to the reliable insulation of a long cable. The insulation in an ocean cable under the pressure of great depth and near the temperature of melting ice that deep oceans approach, might be 15,000 megohms per nautical mile at the fifth minute. With a small incipient fault the insulation might still reach 3,000 megohms per mile and seem excellent, but it is probable that when tested with 5 cells and with 50 cells, the insulation resistance in the latter case would not appear so high. It would also probably be different with the zinc or copper pole to line.

The only value that can attach to a high measured insulation is the assurance it conveys that no flaws exist in its covering or supports, and will therefore remain in good signaling order unless disturbed. In fact a very high insulation as we have seen actually tends to retard signaling. Mechanical security from the loss of insulation is the great desideratum rather than a very high degree of insulation itself.

NOTES ON WIPING CONTACT METHODS FOR CURRENT AND POTENTIAL MEASUREMENT.[1]

BY PROF. BENJ. F. THOMAS.

In the discussion on Mr. Milton E. Thompson's paper on "A Study of an Open Coil Arc Dynamo," read before the Institute on the 21st of May, 1891, Dr. Geyer referred to some work done at Stevens Institute by the writer, in which work the wiping contact method seems to have been used for the first time. The following brief account of the work is presented at the request of several members of the Institute.

In the latter part of July, 1880, President Morton requested the writer to determine the power required to maintain the arc of a Brush arc light, supplied with current by a Brush dynamo machine.

Ammeters and voltmeters were then unknown, and in among the electrical instruments in the Stevens laboratory the most convenient for the purpose seemed to be a tangent galvanometer for the current measurement, and a condenser and Thomson galvanometer for potential. The condenser was a one-third microfarad standard, and the galvanometer a 7,000 ohm, four-coil astatic, both made by Elliott Bros. As every one knows would be the case, trouble was encountered the moment the potential readings began. Wishing to know the character and magnitude of the variation of potential, the writer devised what is now known as the wiping contact method, the natural and only expedient for the purpose.

The condenser was joined, through the usual discharge key, to the terminals (or other points) of the dynamo, by two well-insulated wires. At the dynamo one of these wires was cut, and the cut ends attached to a pair of well-insulated springs of flat metal, mounted on the outer end of a radial arm, the latter fastened to a horizontal rod, coaxial with the armature. A well insulated piece of metal was fastened radially on the face of a disc attached to the armature shaft, and the two brushes set so that they were lightly touched by the radial strip at each revolution of the armature. A pointer attached to the horizontal shaft carrying the radial arm and contact springs, moved over a divided circle on the support of the arm, so that angular positions could be read. The contact device thus acted as an open circuit key, the closing of which, and the consequent charging of the condenser, could only take place when the armature was in a definite position. The process of obtaining the curve of potentials through a revolution of the armature is now so familiar that further description is unnecessary.

In carrying out the examination of the machine, a non-inductive resistance of German silver wires was prepared to avoid complications from the action of the arc lamp. When this was used as a load for the machine, the throws of the galvanometer changed at once from the erratic behavior observed at first, to the beautifully regular and uniform character now so familiar to all who have used the method under proper conditions.

The most interesting curves and results were presented as a joint paper by Prof. Morton and the writer, and read by Prof. Morton before the American Association for the Advancement of Science, at its Boston meeting, Aug. 25–30, 1880.

Our experience with the method leads us to prefer the Thomson portable electrometer and Leyden jars, to all other instruments, for high potential curves. The electrometer is dead beat, is a zero instrument, and is easily and quickly set. As usually made, its constant is from two to three volts per division, and one can easily set to within that amount. The error resulting from an improper reading, say one division wrong, would be of course serious in reading low potentials, but these readings only occur on nearly straight parts of high potential curves, and might be entirely omitted without serious error.

Next to the portable electrometer, we prefer the Thomson electrostatic voltmeters. For low potential curves nothing has yet proven superior to the potientiometer method as used here, and described by the writer at the American Association meeting at Washington, last August. The potential difference to be measured is balanced against that produced by a battery in a resistance as in the accompanying illustration.

In Mr. Thompson's paper referred to above, reference is made to Joubert's use of the method in 1881, and in the recent edition of Thompson's Dynamo-Electric Machinery, it is described as Joubert's method. In view of the work here described, and its presentation before the American Association in 1880, it seems proper to claim the method, which in the hands of Prof. Ryan, Dr. Duncan and others has led to such valuable results, as an American method.

"A POSITIVE PLEASURE TO READ YOUR PAPER."

In a communication dated July 2, the Standard Paint Co., of 2 Liberty street, this city, write us as follows: "We certainly think that the article descriptive of the plant and processes of the Thomson-Houston Co. is one of the most complete papers of the kind we have ever seen published. It has become a positive pleasure to read the recent issues of your paper, and its growth, which has been marvelous, has kept pace with the rapid developments in the electrical field. We congratulate you on your last issue and on the valuable journal you publish. We shall be pleased at all times to give your paper such support as it is possible for us to do, and with good wishes for its future welfare, in which Mr. Shainwald, our president, asks to join, we remain, yours very truly, The Standard Paint Co., per Frank S. De Rond."

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[1] Abstract of a paper read at the general meeting of the American Institute of Electrical Engineers, Chicago, June 6, 7 and 8, 1892.

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There can be no reality in science if at this late day it cannot predict that certain proposed inventions are impossible, as well as declare that others are in accordance with established principles.—Joseph Henry.

TEN YEARS OF THE TELEPHONE IN AMERICA.

AS a matter of fact the development of the telephone in this country has taken place within the period between 1880 and 1890, so far as it constituted a large business based on the central exchange. Before 1880, as the Tenth Census report said, "the business amounted to little or nothing," yet at the end of 1880 it had already established itself as one of the great fields of electrical invention and investment. With 1890, began another active period of great importance, that of long-distance telephony, and now it is evident that the decade dating from that year will also witness an enormous development of the telephone as a means of intercommunication in residences, hotels, offices and factories. Even to-day the office of THE ELECTRICAL ENGINEER is practically the only place in New York City, outside the telephone headquarters, where a number of telephones have been installed by means of which, without a switchboard and a switching operator, several persons or departments can converse freely with each other. There is no end to the opportunity for such work, yet as we all know, and as the fact just mentioned indicates, this special development has but barely begun.

The figures compiled by Mr. A. R. Foote for the Census Office, in regard to the telephone industry, have just been issued in Census Bulletin, No. 196, and are Mr. Foote's first publication as special agent in charge of electrical statistics. The work appears to have been done with intelligence and accuracy, as might have been expected. The grand totals are embodied in the subjoined table of the Eleventh Census:

Items.	1880.	1890.	Increase. (Amount and number.)
Number of companies, firms, and persons reporting	148	53	
Total investment	$14,605,787	$72,341,736	$57,735,949
Gross earnings	3,098,081	16,404,583	13,306,502
Gross expenses	2,373,703	11,143,871	8,870,168
Net earnings	724,378	5,260,712	4,536,334
Number of exchanges	439	1,241	804
Number of telephones and transmitters	108,638	467,356	358,718
Miles of wire	34,305	240,412	206,107
Number of employees	3,338	8,645	5,307
Number of subscribers	48,414	227,357	178,943
Number of conversations	....	453,200,000	

It will be observed that the number of operating companies is little more than a third of what it was in 1880, and it is not unsafe to predict that consolidation will be carried still further. As to the profitableness of the industry, about which so much is heard, it would appear from an analysis of the figures that the per cent. of net earnings on total investment in 1890 was 7.27, and that the per cent. of aggregate dividends on share investment was 4.70. Such figures certainly do not bear out the extraordinary statements that have been made from time to time in the daily newspapers as to the profits of the telephone business, nor does the fact of an undue return on the investment appear in any of the other figures of the report. It is true that there is no definite information given as to the cash investment, so as to show how great or little has been the amount of "water" injected; but such figures would not be at all a fair test of values, as the capitalization to-day should properly cover many valuable elements such as rights of way, city franchises, improved real estate, good will, etc. It might also, perhaps, be held to cover a fund of experience bought very dearly during ten years of trial, experiment, failure and success, with a variety of methods and apparatus that long since went into the junk heap and were written off.

The report is but fair in saying that the service is more valuable and satisfactory to the subscriber to-day than it was in 1880, due to the introduction of better instruments, the resort to metallic circuits and probably to numberless little fine touches in supervision and management that have been added so gradually that it would be hard to tell just when the change was made. Some idea of the trouble and expense to which the operating companies have gone is furnished in the brief statement that they now have 54,690 miles of wire underground.

Surprise is often expressed at the statement that the service in the larger exchanges costs more than in the smaller, and hence must be more highly paid for. One of the tables included by Mr. Foote shows that the average of calls daily per subscriber runs from 4.80 per day in exchanges with 100 subscribers and less up to 8.86 per day in exchanges of 1,500 subscribers and over. Here are the extremes within those limits, but in the largest exchanges the number of calls is often even greater. Yet the average price paid per subscriber per call only rises from 3.25 cents to 3.50 cents, the lowest price being paid, naturally, in the handy little exchanges of about 1,000 to 1,500 subscribers.

STORAGE BATTERIES IN CENTRAL STATIONS.

We may be pardoned for again recurring to a subject to which we have alluded a number of times recently, but the importance of the matter justifies us in again calling attention to results which bear out our previous estimate of the value of storage batteries in central station work. Another set of independent figures on the subject have been given in *L' Industrie Electrique*, made by M. Vitte, at the electric light works of the gas company at Lyons, France. The cells there employed are of the Tudor type, and from the 5th to the 31st of March, that is 26 days, they were given a charge of 2,828 kilowatt hours. They gave a discharge of 2,477 kilowatt hours, thus showing an efficiency of 87½ per cent. The battery has a practical capacity of 150 kilowatt hours, but is only worked up to two-thirds of its capacity at the present time. The above figures lead M. Vitte to the conclusion that, contrary to the general opinion, the storage battery is an apparatus possessing the highest mean monthly efficiency. These figures bear out very strongly the statements made in one of our recent issues by Mr. Currie, regarding the work of storage batteries in the central stations of Paris and ought to lead to some active consideration of the subject in this country.

INCANDESCENT LAMP LIFE AND EFFICIENCY.

The life and efficiency of incandescent lamps has long been a favorite topic of investigation, and has from the very birth of the lamp given rise to discussions, some of which, indeed, have not been of the most pleasant nature. That the subject is still considered a live one, and perhaps justly so, is evident upon the perusal of the paper read by Prof. Thomas and Messrs. Martin and Hassler, before the American Institute of Electrical Engineers at Chicago. It is not to be wondered at, of course, that we should find some differences in the life and efficiency of the various makes of lamps tested, but viewing the tests broadly, they show, with the exception of one or two makes, tolerably uniform performance within the limit of six hundred hours, and even beyond that point. Collectively, the tests show that a decided improvement has been achieved in the incandescent lamp manufacture during the last five years, but it is to be regretted that obvious considerations make it impossible to reveal the identity of the lamps and thus prevent a discussion of the subject from the standpoint of the method of manufacture. It would be of the greatest interest to know which among the lamps have their filaments treated by the flashing process, and which have not; while a disclosure as to the nature of the fibre employed would also be of great value. But the paper has served to bring out a fact which may prove of the greatest importance in the future manufacture of incandescent lamps. The blackening of the lamp to-day constitutes its most serious defect, and if it should be demonstrated after further tests, that by the employment of mechanical vacuum pumps exclusively, blackening can be avoided, as the tests of Prof. Thomas and his associates seem to show, it would prove one of the most imprortant advances made since the manufacture of incandescent lamps was begun. The paper also draws attention to a matter which must sooner or later call for action from some authoritative body, that is, the determination of the life of an incandescent lamp. The authors of the paper incline to the opinion that when a sixteen-candle lamp has dropped to fourteen candle power at the end of two hundred and forty hours its life is ended; but we are scarcely inclined to concur in this estimate, and need only to refer to the millions of feet of alleged twenty-candle gas, which the gas companies are selling, and which in many cases hardly reaches fifteen candles, without evoking any complaint from the consumer. Something between the limits suggested by the authors, and that proposed by others, namely, when the lamp has fallen to one-half its ordinary candle power, would seem to be more equitable to all concerned.

TESTING ARC-LIGHT CIRCUITS.

The difficulties attending the testing of a "live" circuit of any kind are greatly enhanced when the potential is very high, and hence it has come to be a general practice to delay hunting up trouble on arc circuits until after the circuits were shut down. Some approximate methods of testing have been in vogue, but the value of a method which will enable the station manager to locate accurately the cause of trouble will be at once recognized. A testing arrangement by which this is accomplished is described elsewhere in this issue by Mr. Edgar E. Stark, who has employed it with marked success for some time past. The value of accurate measuring instruments, such as the Weston voltmeter, is here again demonstrated. With this method available, there ought now to be little excuse for the long existence of dangerous grounds on arc circuits, which, besides the constant menace they offer to the safety of the station employees, may be the cause of no little waste of current.

MT. WASHINGTON'S SEARCH LIGHT.

Some little time ago note was made of the proposal to place a very powerful search light on top of Mt. Washington. It is now stated by General Manager Tucker, of the Maine Central Railroad, that sufficient money has been raised to carry out the plan. The light will be the highest and strongest in the world, and will be visible from Maine, Vermont, Massachusetts, New Hampshire, Canada and New York. It is proposed to signal from the mountain to Boston and other cities; even to Montreal. Although no special reference has been made to the value of such a prominent search light for army signaling, it must be evident that the proposed installation offers exceptional opportunities for testing the value of the projector as a military signaling device.

ONE OF OUR UNAPPRECIATED MERCIES.

Mr. W. Crookes is credited with saying at the recent conversazione of the Royal Society that the only reason the earth has not long ago been deluged in a sea of nitric acid is that the igniting point of nitrogen is higher than the temperature produced by its combustion, and therefore the flame is not hot enough to set fire to the adjoining gas. Were it not for this, the first lightning flash would probably have fired the air, seriously interfered with the development of the world and made things generally uncomfortable.

A LIFE AND EFFICIENCY TEST OF INCANDESCENT LAMPS.[1]

BY PROFESSOR B. F. THOMAS AND MESSRS. P. MARTIN AND R. H. HASSLER.

MUCH has been written and said concerning the efficiency of the incandescent lamp and of the relation between its efficiency and the length of life to be expected from it. High efficiency lamps have their advocates and low efficiency lamps have theirs. It is pretty well understood by those whose work has put them in a position to appreciate the facts, that the question as to the choice of the lamps which will have best influence on the profit and loss account of the consumer depends on other things than first cost, efficiency and life. It is understood by such persons that the cost of producing the current supplying the lamps and the steadiness of voltage maintained on the lines are important factors in the choice, the high efficiency, short life lamp being best under condition of steady voltage and expensive current, and the low efficiency, long life lamp where current is cheap or regulation poor.

There is as great divergence between the published claims of lamp makers and the statements of the experience of station managers. Makers generally say that they will guarantee 600 hours' life for their lamps, and from 10 to 14 or more lamps per horse power, but some station managers insist that they do not get an average of 400 hours' life.

Considering it of prime importance for our object that the lamps tested should be of the same character as those usually sold to consumers, we bought some lamps of regular dealers, as in the usual course of business, and obtained others from lots supplied for central station use. Lamps of the following makes were obtained, no attempt being made to get lamps of any given efficiency of any make: A. B. C., Beacon, Columbia, Economic, Packard, Pennsylvania, Standard, Thomson-Houston, Edison, Perkins, Sawyer-Man and Steuben. In ordering (through persons purchasing for us in Chicago and New York) we called for ten 110-volt lamps of 16 c. p. in each case, but on receiving the lamps we found three lamps out of ten of one make labeled 111 volts. The three were excluded and seven put in, but another lot of ten of the same make, correctly labeled, was obtained. Ten of another make were received with the original marking, 111 volts in ink, changed by pencil to 110 volts. They were also excluded, and a new lot of ten of that make, correctly labeled, obtained. Ten Sunbeam lamps were divided into two lots of five each, evidently supplied as a sample lot, and were excluded. We could not get others of that make in time to enter the test. There were, therefore, in all 127 lamps, labeled 110 volts and 16 c. p., of 12 well-known makes, 17 lamps in two separate lots of one make, and ten each of 11 different makes.

A Thomson centiampere balance provided also with a resistance for obtaining standard potential readings was used as a standard for current and potentials. Two Weston milliampere meters and two Weston voltmeters were used in the current and potential readings on the lamps.

Current was supplied to the lamps by a 200-light Thomson-Houston dynamo, of the spherical armature type, which proved to be an excellent machine for the purpose. Owing to the variable speed of the engine, due to varying load and steam pressure, a special automatic regulator was devised and applied to the dynamo, to keep the potential at the centre of distribution constant. This was effected by causing a small motor to slide a contact-piece along two vertical German silver wires joined to an extension of the field coil of the dynamo, a current being sent through the motor in one direction or the other as needed, by relay points, the relays being controlled by an indicator attached to wires leading to the centre of distribution. As used, the combination proved very satisfactory, keeping the potential difference at the centre at 110 volts, within a limit of ¾ of a volt either way. It could readily have been set to a smaller margin, but that was not considered necessary.

For the candle power measurements a two candle power Methven screen was used, the gas being passed through a Methven carbureter containing pentane. Its constant was checked by standard candles. Three 32 c. p. Edison lamps were used as working standards.

Before the duration test began the mean horizontal candle power of each lamp was determined in the usual way, and the ratio of this mean to the candle power found when the plane of the ends of the filament was perpendicular to the photometer bar was found, and used as the distribution factor. All results are expressed in terms of mean horizontal candle power. The unavoidable delays encountered in starting the test made it impossible to determine the spherical distribution without cutting short the time of run which we had set as desirable, viz., 1,200 hours. The duration test was begun on March 17, and it was necessary to run night and day, Sundays excepted, until the night of May 14, to complete the 1,200 hours. The run began with 77 lamps on the rack. The remaining 50 lamps were received later, and placed on the rack with the others 187 hours after the start.

As the methods used involve nothing particularly new, and have been fully described in print many times, we have considered it unnecessary to do more than state the general outlines, as above.

The object we had in view in undertaking the test was to determine the character of the incandescent lamp as a commercial product, not as a scientific instrument. The number of lamps of each make taken was, of course, too small to base a fair judgment on as to the absolute or relative merit of the lamps generally sold by the makers. For that purpose some hundreds of lamps of each make, taken from different lots, would have to be tested, which it was of course impossible for us to do. For this reason we have considered it unfair to the several makers concerned to give their names in connection with the results on their lamps, but have instead designated each make by a letter, and each lamp by a number. We believe, however, that the average of the results of all makes may be taken to represent fairly well the character of the average commercial lamp.

The results of the test are given in the following tables, the values given being in each case the average for a given make of lamp. Table I gives in the second column the average value of the distribution factors found for the 10 lamps of make "A," and the average value of the mean horizontal candle powers for those lamps at intervals after the beginning of the duration test, expressed in hours by numbers in the first column. The third column gives corresponding values for the lamps of make "B," and so on. Table I includes the lamps started March 17. Table II contains similar data for the lamps started 187 hours later.

TABLE I.

Lamp.	A	B	C	D	E	F	G	K
Distribution factor.	1.05	1.07	1.01	1.11	.989	1.01	1.01	1.02
Hours from start.	C. P.	C. P.	C. P.	C. P.	C. P.	C. P.	C. P.	C. P.
0	16.0	13.1	14.1	16.1	15.9	14.2	17.1	17.0
93	15.0	12.4	14.8	16.1	13.7	12.1	15.9	16.1
233	13.65	12.4	14.9	16.0	13.1	12.9	16.4	16.5
324	12.2	11.0	14.8	13.9	10.9	10.8	14.5	13.9
392	11.7	10.5	14.0	13.2	10.5	10.4	13.6	13.4
411	11.8	10.2	14.2	12.7	10.1	10.2	13.3	13.1
537	10.9	9.9	13.6	12.3	9.9	10.0	13.0	13.0
637	10.7	10.1	13.0	11.9	9.5	10.1	12.4	12.4
785	9.4	9.2	12.6	10.5	9.1	9.1	11.4	10.9
833	9.1	8.6	All out	10.1	8.5	8.5	10.9	10.3
883	8.6	8.2	....	9.3	7.7	8.0	10.4	9.8
972	8.6	8.3	....	9.2	7.6	8.0	10.4	10.0
1,105	8.6	8.2	....	9.2	7.4	8.0	10.3	9.5
1,190	8.2	8.0	....	9.0	7.5	8.0	10.4	9.6

TABLE II.

Lamp.	L.	M.	N.	O.	P.
Distribution factor.	1.10	1.00	.911	1.00	1.02
Hours from start.	C. P.	C. P.	C. P.	C. P.	C. P.
0	13.2	12.5	14.1	17.9	11.6
71	12.6	12.5	13.5	....	...
137	10.7	12.6	11.7	16.4	15.9
205	10.1	11.9	11.0	14.8	13.6
254	9.7	11.6	10.4	14.0	13.0
319	9.3	11.8	10.1	13.3	12.3
450	8.9	11.5	9.4	11.6	11.6
598	7.8	10.6	9.3	10.8	9.7
646	7.6	9.6	8.2	9.6	9.2
696	7.1	9.3	7.9	9.0	8.4
785	7.1	9.4	7.8	9.0	8.7
887	6.8	8.7	7.5	8.3	8.5
1,003	7.1	8.8	7.4	8.0	8.4

Table III gives the average current strength found for each make of lamp, at times given in the first column:

TABLE III.

Lamp.	Mean current strength in amperes.												
	A.	B.	C.	D.	E.	F.	G.	K.	L.	M.	N.	O.	P.
Hours.													
0	.567	.532	.693	.639	.589	.532	.662	.613	.458	.547	.568	.609	.536
100	....	....	...	...	..	....	....		.444	.582	.557	.665	.534
107	.575	.545	.760	.668	.581	.519	.689	.629	....	..	...	....	....
275	.567	.540	.778	.655	.566	.516	.681	....	....	....	..	....	....
380	....	...	...	....	....	....	..	....	.425	.513	.528	.615	.511
555	.548	.540	.770	.633	.541	.504	.662	....	....	..	....	....	....
615	....	....	...	....	....	....	...	...	.418	.505	.519	.595	.495
790	.540	.535	.770	.619	.530	.498	.654	.581	....	....	....	....	....
930	....	....	....	....		....	..	....	.417	.500	.508	.585	.476
1,105	.535	.529	.000	.611	.517	.495	.649	.577	....	...	....	.	....

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[1] Abstract of a paper read at the general meeting of the American Institute of Electrical Engineers, Chicago, Ill., June 6, 7 and 8, 1892.

Table IV gives the mean percentage of original candle power for each make at times given in the first column:

TABLE IV.

Lamp.	A.	B.	C.	D.	E.	F.	G.	K.	L.	M.	N.	O.	P.	Average
Hours.	%	%	%	%	%	%	%	%	%	%	%	%	%	%
0	100	100	100	100	100	100	100	100	100	100	100	100	100	100
100	98	94	106	101	92	93	95	93	87	100	87	95	107	95.6
200	86	89	109	99	84	86	90	87	78	98	79	87	97	90
300	79	83	106	93	77	81	86	83	72	94	72	80	86	84
400	74	80	102	82	72	77	81	78	67	90	67	72	78	78.4
500	69	78	98	75	66	70	77	74	63	86	63	66	71	73
600	64	70	94	70	61	66	73	70	59	80	60	60	65	68.6
700	61	67	91	66	57	62	70	67	55	75	56	55	60	64.7
800	58	64	90	63	53	59	66	63	54	73	55	51	58	62
900	55	63	All out.	60	51	57	63	59	53	70	53	49	56	57.4
1,000	54	62	....	58	49	56	62	58	54	70	52	47	57	56.6
1,100	52	61	....	57	47	56	61	57	..	....	....	....	....	55.8
1.200	51	61	....	56	47	56	61	57	....	....	....	....	....	55.4

Table V gives the average watts per mean horizontal candle power for each make, at times given in the first column:

TABLE V.

	Watts per mean horizontal candle power.													
	A.	B.	C.	D.	E.	F.	G.	K.	L.	M.	N.	O.	P.	A.
Hours.														
0	3.9	4.4	5.4	4.8	4.1	4.1	4.2	3.9	3.8	4.8	4.4	3.9	4.0	4.2
100	4.3	4.8	5.6	4.5	4.4	4.3	4.6	4.3	4.2	4.7	4.9	4.5	3.8	4.5
200	4.6	5.1	5.6	4.5	4.7	4.6	4.9	4.6	4.6	4.7	5.3	4.9	4.1	4.8
300	4.9	5.4	5.7	4.8	5.0	4.9	5.0	4.8	4.9	4.8	5.7	5.2	4.5	5.0
400	5.2	5.6	5.9	5.3	5.4	5.1	5.3	5.0	5.2	4.9	6.1	5.4	4.9	5.3
500	5.5	6.1	6.2	5.8	5.7	5.5	5.5	5.2	5.5	5.1	6.3	5.8	5.2	5.6
600	5.8	6.4	6.4	6.1	6.1	5.8	5.7	5.4	5.8	5.5	6.7	6.3	5.6	5.9
700	6.1	6.7	6.6	6.4	6.5	6.1	6.0	5.6	6.1	5.8	7.0	6.9	6.1	6.3
800	6.4	6.9	6.7	6.7	7.0	6.4	6.3	5.9	6.3	5.9	7.2	7.4	6.2	6.6
900	6.7	7.0	......	7.0	7.2	6.6	6.6	6.2	6.4	6.1	7.4	7.7	6.3	6.8
1,000	6.8	7.1	......	7.2	7.4	6.8	6.7	6.4	6.2	6.1	7.5	7.9	6.2	6.8
1,100	7.0	7.2	....	7.3	7.6	6.7	6.8	6.5	..	...	....	....	....	7.0
1,200	7.1	7.2	......	7.4	7.6	6.7	6.7	6.5	....	....	....	....	....	7.0

Thirty-one lamps in all were broken, distributed as follows: All of the C's (10), 2 D's, 8 E's, 2 K's, 4 L's, 1 M and 2 N's. All the lamps of A, B, F, G and O makes survived, the O's for 1,018 hours, the others for 1,200. The average life of the C's was 836 hours.

Plate XIV gives two sets of curves. One set gives the curve of general average of percentage of initial candle power with respect to time, derived from the averages of the several makes, and beside it the curve of the make which showed highest percentage throughout, marked min. drop, Make M, and also the curve showing lowest percentage, marked max. drop, Make L. The other set shows the general average of watts per candle power, and also the curves of the two makes showing the maximum (make N) and minimum (make M).

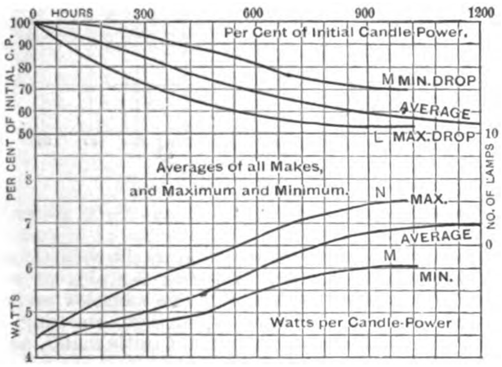

Plate XIV

Examining the results first for candle-power, we find the value 14.5 as the average of all the lamps tested at the time the current was first turned on them. Of the 13 separate lots, six only show an initial candle power of 16 candles (neglecting tenths), though one make which started at below 15 rises above 16 within the first 100 hours. The lowest initial candle power is found for make M. Makes G, K and O start at 17 candles, the highest figure reached at the start.

Looking at the curve which gives the average percentage of initial candle power, Plate XIV, we find that the lamps on the average grow dim at a steady rate, falling off to 90 per cent. in about 200 hours, to 68 per cent. in 600 hours, and end at 1,200 hours with a little less than 55 per cent. Deferring the consideration of the C lamps, the M lamps sustain their power best, losing only about 6 per cent. in the first 3 0 hours, and ending a little under 70 per cent. of their initial candle power. The L lamps drop rapidly on the start, losing 30 per cent. in the first 300 hours and ending at 54 per cent. The E's and the O's drop to 47 per cent. at the close, but sustain themselves better than the L's in the earlier part of the run.

With respect to efficiency, using the term in its ordinary signification, as measured by watts per candle power (though in this sense the reciprocal is the proper measure), Plate XIV shows an average initial value of 4.2, rising to 5.0 at 300 hours, 5.9 at 600 hours, 6.8 at 900 hours, and 7.0 at the end. The M lamps again have the best place, starting high but ending low, at six watts per candle power.

But what shall we say of the results as bearing on the question of the life of the lamp? The answer depends on what we shall define the life of a lamp to be.

Is a lamp alive as long as current will go through it? Adopting this view, our test shows 96 out of 127 lamps decidedly alive at the end of an average of 1,120 hours, and the leveling of the average curves of Plate XIV promises a considerable extension of their existence; 31 only have proven their mortality, and several of them lived to a good old age. The C's, poor things, all died young.

If we set the time of decease at the time when the lamp gives 50 per cent. of its initial candle power, as some claim, the lamps tested have passed 1,000 hours on the average, and certain makes have passed 1,200. If life be defined still with reference to percentage of initial candle power, but the limit be placed at 75 per cent., some individuals are still alive, but on the average, all died at 450 hours; 80 per cent. as limit cuts them off at 330 hours, and 90 per cent. at 180.

But there is yet another way of defining the life of a lamp. The one who ultimately pays for the lamp is the one whose premises are lighted by it, and the thing he is supposed to pay for is light. For him, the lamp is dead when it ceases to give a certain candle power, without reference to what its candle power was when it was new. His premises, let us suppose, are properly lighted by a certain number of new lamps which actually give 16 c. p. But when their light drops to 14 (12½ per cent.), he is no longer satisfied (and he ought not to be). For him the average lamp lasts about 240 hours. But if he is at liberty to choose the make of lamp, without reference to its efficiency, he will probably call for lamps of the G make, and get 400 hours' service from them. If, however, he can induce the maker of the M lamp to make a lamp giving 16 c. p. when new, and having the same characteristics as those we tested, he will chose M's, and get 500 hours' life. And that is the best that can be done for him, so far as this test shows. He would not have B's, L's or M's, as at present made at all, because they do not give 14 c. p. when new, and if the station manager put in F's or N's he would order them out in less than a week. The state of things revealed by this test, as to the actual candle power of new lamps, is certainly not what it ought to be.

At the conclusion of the life test we dismounted all the lamps and placed them on a large table covered with clean drawing paper and uniformly lighted. The several lots were carefully examined with reference to blackening, the lot which was blackened the most being graded 100, and the other lots graded as closely as we could judge by comparison with the blackest lot and with one another. The grades are as follows: 10, 12½, 25, 28, 30, 32, 35, 42, 45, 50, 75 and 100 per cent. of the blackening of the blackest lot. When the sorting and grading were satisfactorily completed, and the letters on the lamp bases examined, it was remarked that *the two lots which were least blackened were of the makes which are advertised as exhausted by mechanical pumps.* That they should both be so much alike in blackening, and both only one-half as much blackened as the least blackened of the mercurially exhausted lamps, is, to say the least, worthy of notice. It is, of course, not established that the observed freedom from blackening is due to the absence of mercury vapor in the lamps, as the makers claim, but if investigation should establish the claim the mercury pump will probably become once more a laboratory instrument. [The lot of lamps graded 10 per cent. and the lot graded 100 per cent. were mounted together on cardboard and exhibited.]

So far as the lamps tested may be considered to fairly represent it, we draw from the test the following conclusions concerning the average 16 c. p., 110 volt, incandescent lamp:

First. The mean horizontal candle power of the lamp as defined is only 14.5 when, new instead of 16 as labeled.

Second. The candle power of the lamp diminishes at a fairly uniform rate as it is burned, the rate of decrease being roughly 10 per cent. of the initial candle power for each 200 hours burned.

Third. The lamp makers' claim that the lamp will burn for 600 hours before breaking, is more than established, 96 out of 127 lamps being unbroken at the end of over 1,100 hours.

Fourth. Defining the life of a lamp to be the number of hours it will burn before it will fall from 16 c. p. to 14, we find the life of lamps in all respects like those tested, but so made as to give an initial candle power of 16, is 240 hours

Fifth. The initial efficiency of the lamp is 4.2 watts per candle power. At 600 hours it is 5.9 watts and 1,200 hours 7 watts. The average efficiency during the first 600 hours is 5.04 watts.

Sixth. There is considerable difference in the rating of lamps by different makers, who nominally furnish the same article, the average initial candle powers of the several lots ranging from 12.5 to 17.0. There is also considerable difference in the uniformity of the product of different makers.

The above conclusions properly complete this paper, so far as the purpose for which the test was undertaken is concerned. Some interesting points in the relative performances of different lamps may perhaps be alluded to in addition, since they cannot affect the makers.

The most interesting result arises from a comparison of the lamps L and M. The L's have the highest initial efficiency (3.8), and the M's the lowest (4.8), excluding, of course, the C's, which cannot be classed with good lamps, but after 250 hours' burning the efficiencies are the same (4.75). At the start the L's are furnishing light at the least cost, but after 250 hours the M's have the advantage in this respect. If we suppose both makes to be used for 700 hours, the average efficiency is the same for both. But at this time the M's are giving 75 per cent. of their initial candle power, while the L's are giving only 55 per cent. For the consumer the M lamp then is the better of the two, since the lighting of premises will be more uniform throughout the 700 hours of use supposed, and the cost of current for a given aggregate of candle power hours is no greater than with the L's. If the time of use of the lamps be, say, 400 hours, the choice is not so evident, and will depend on whether the slight difference in cost (watt hours) is of greater or less importance than constancy of candle power of the lamps.

The paper was accompanied by a series of curves showing the behavior of each individual set of lamps.

THE MAGNETIC PERMEABILITY OF SPECIAL IRONS FOR ELECTRICAL PURPOSES.[1]

BY MILTON E. THOMPSON; PERCY H. KNIGHT; AND GEO. W. BACON.

THE writers have recently made, in the laboratory of Cornell University, quite a number of tests of samples of various special irons from different manufacturers throughout the country; it was believed that some of the results obtained would prove of interest to the general electrical fraternity. The method used for these tests was a modification of that used by Rowland, the samples being prepared in the form of rings, and wound with two sets of windings, a primary and a secondary. The magnetizing current was passed through the primary circuit and measured by means of a Weston ammeter. A ballistic galvanometer placed in the secondary circuit measured by its throw the magnetic induction due to any given change in the magnetizing current.

Two different plans were tried in taking the curve and found to give slightly different results. The first was the reversal method, in which the current was commenced at its maximum value, and its direction reversed several times by means of a reversing switch, in order to bring the magnetism up to its full value, the secondary circuit being open during this operation. The secondary was then closed through the galvanometer, the current reversed, and the induction measured by the throw. The current was then slightly reduced, reversed several times as before, and the induction again measured on reversing the current. In this way the magnetizing current was gradually reduced to zero, and from the data thus obtained, curves were plotted with magnetic lines per square centimetre for ordinates and magnetizing force for abscissæ. In the other method, which was used for taking most of the curves, and which gives results more nearly like those obtained by Hopkinson and which are generally accepted as standards for wrought and for cast iron, the sample was first completely demagnetized. In some cases this was done by simply reversing the current through the primary and at the same time gradually reducing it to zero. By this method however, no samples except those composed of wrought iron sheets were successfully demagnetized, which might suggest that the Foucault currents set up by the reversal of the magnetizing current tended to keep up the magnetization. An alternating current of both high and low periodicity was also tried without success, and it was only by finally heating the samples to a cherry-red heat and allowing them to cool in air, so as not to change materially their softness, that total demagnetization was obtained. The sample being demagnetized, a small current was passed through the primary and the induced magnetism measured by the throw of the galvanometer. The current was then slightly increased and the deflection of the galvanometer again noted, and so on up to the maximum magnetizing force, the current being gradually increased step by step. The current was then reduced step by step to zero, reversed, and increased step by step to a maximum equal to that of the other direction. This descending and reversal curve was taken simply to serve as a check upon the demagnetization and upon the accuracy of the observations of the ascending curve and only the latter was plotted. Curves obtained from the same sample by the reversal method and by the step-by-step method were found to differ from each other by eight or ten per cent. at maximum values, the curves by the reversal process reaching the higher values. The magnetization of field magnets of dynamo machinery would probably reach values higher than that given by either of these methods of testing, for the iron being subject to vibrations from the rotating parts of the machine, and being at the same time under a continuous magnetizing force, would no doubt reach as high magnetic values as could be obtained by any method of testing.

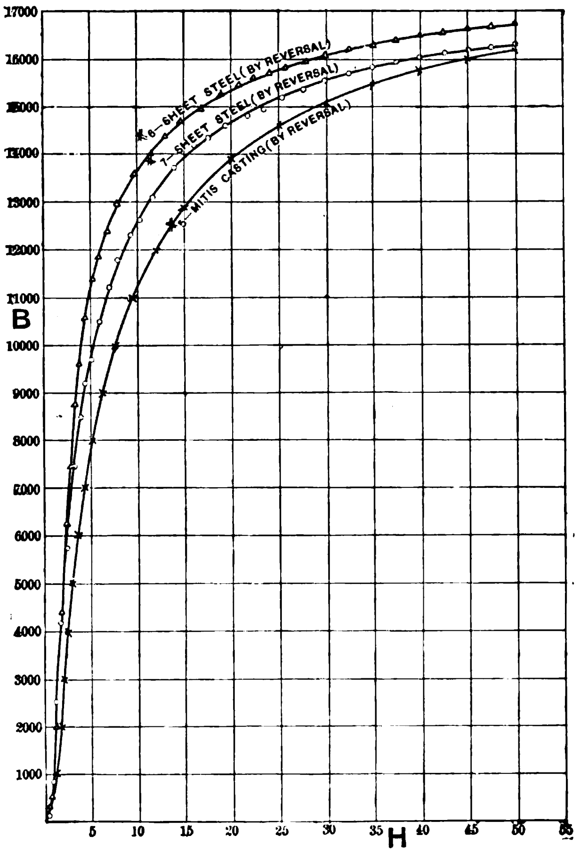

FIG. 1.

Some of the results obtained are embodied in the accompanying curves. Those in Fig. 1 were all taken by the reversal method. Curve No. 5 is the average of two different samples of wrought iron castings from the same maker, the two samples prepared at different times and from different pourings, showing almost identical qualities. The magnetic value of mitis metal, as shown by curve No. 5, differs very little from that of steel of good quality, as shown by curve No. 4. Curves No. 6 and No. 7 are from two samples of sheet steel of somewhat peculiar manufacture, inasmuch as they are said to contain no manganese, that element being perhaps the most objectionable impurity in mild steel, so far as its magnetic properties are concerned. The two samples from which the curves were taken were made as an experiment, and by slightly different processes. They show excellent magnetic values, especially No. 6, and seem to indicate that sheet steel may some day come into extensive use for armature cores, etc. Curves No. 14 and No. 15, Fig. 2, represent two different samples of wrought iron, used by two electric companies for field magnets. These curves were taken by the reversal method, and indicate for the metals a value considerably below that of the best wrought iron. Curves No. 16 and No. 17 are both from the same steel casting, and show the difference between the step-by-step method and the reversal method. Curve No. 16 is by reversal, and No. 17 by step by step. Curves No. 18 and No. 19 are both from one sample of sheet iron, No. 18 being taken by the reversal method, and No. 19 by the step by step. A similar difference in the methods is indicated by these two curves. A comparison of these and other curves plotted seemed to show that there is still a chance for the standard of cast iron to be raised, that the magnetic value of the average steel casting is only about eight per cent. below that of the best wrought iron, that there is practically very little difference in the magnetic values of steel castings of the best quality and mitis castings, and there seems to be no good reason for believing that the former cannot be made of quite as good quality as the latter.

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[1] Abstract of a paper read at the general meeting of the American Institute of Electrical Engineers, Chicago, June 6, 7 and 8, 1892.

The magnetic values of both of those metals are found to be so far superior to that of cast iron that it seems quite certain that only the cost of production can stand in the way of their rapid and almost universal introduction for field magnets of dynamos and motors. When we consider that the cost of steel rails is but little different from that of cast iron, it seems reasonable to suppose that when the art of making steel castings comes to be better known and more fully understood, and better facilities are provided for their manufacture, such castings can be produced at a cost but little in excess of that of cast iron. Considering then the great superiority of cast steel over cast iron for electrical purposes, it seems safe to predict that the day is not far distant when steel castings will almost entirely replace cast iron in the construction of dynamo machinery, and the improvement in such machinery resulting from this change will be perhaps one of the greatest steps that has ever marked the progress of the electrical industry.

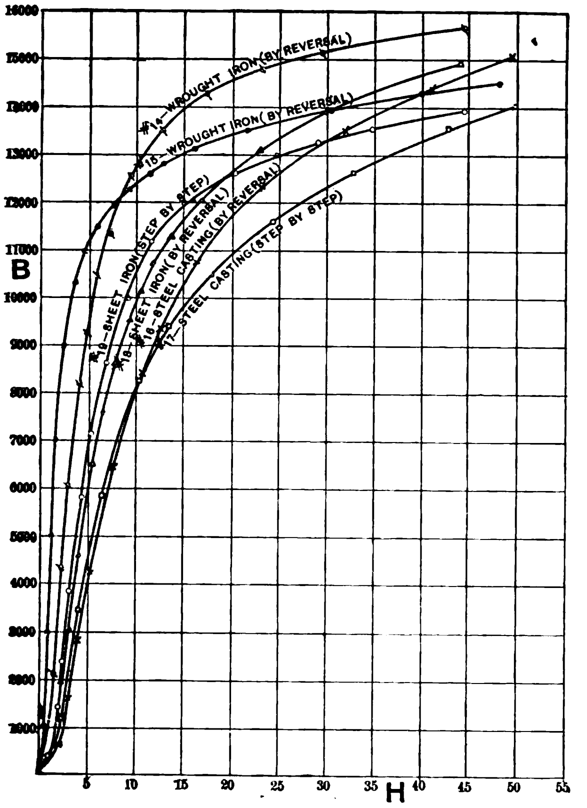


FIG 2.

SPORTS IN CANADA BY THE ELECTRIC LIGHT.

A SUCCESSFUL application of the arc light to the illumination of out-door grounds, in order to permit athletic sports and races to be held at night, has just been made by the Citizens' Electric Light and Power Co., of Montreal, at the grounds of the Montreal Amateur Athletic Association, on the occasion of their annual spring games. The programme included putting-the-shot, jumping, foot races and bicycle races, which events were seen by the spectators, with the aid of the electric light, nearly as well as by daylight and without the discomfort of the heat of the sun.

Heretofore these games took place on Saturday afternoons, but the experiment just made has shown that it is more advantageous to hold them at night, owing to the larger attendance of spectators; more people having time to attend in the evening, and there being, besides, no counter attractions then, such as la crosse or baseball matches. So successful was this experiment that the association will repeat these performances each month during the summer. In the fall it is their intention, instead of holding football matches in the day time, to hold them at night by the electric light. As proof that the public are pleased and attracted by this innovation, it may be stated that the recent games were held on two evenings, a week apart, and that the attendance on the last evening was considerably larger than on the first night.

The grounds in question are 650 feet by 560 feet and have a third of a mile track. The grand stand is 780 feet in length. After trials of different arrangements, it was found that the best illumination was given by 17 arc lamps of 2,000 c. p. each, located around and directly above the outside edge of the track. Eight of the lamps are placed along the front of the grand stand, in order to secure a more brilliant illumination of this portion of the track, where the field and sprint events take place and the long-distance races finish. The remaining lamps are distributed at equal distances apart around the rest of the track supported on projecting arms. At first the lamps were provided with clear glass globes, which, it was found, cast on the track troublesome shawdows of the globe holders; this objection was entirely overcome by the use of ground-glass globes.

Legal Notes.

EDISON LAMP PATENT SUSTAINED IN AUSTRALIA.

IT may be a matter of interest in connection with the suit of the Edison Electric Light Company against the United States Electric Lighting Company on Mr. Edison's filament patent No. 223,898, which was argued before the Court of Appeal in this city in April, and on which a decision is soon expected, that the corresponding patent in New South Wales, Australia, was sustained in that country in October last.

A report of the case taken from the Sydney *Morning Herald*, of October 12 and 14, 1891, states that the Australian patent was dated March 2, 1880, and corresponds with the patent granted in the United Kingdom November 10, 1879. This patent is owned by the Brush Electrical Engineering Company, Limited, and suit was brought against H. H. Kingsbury, a former agent in New South Wales for the Edison Indian and Colonial Electrical Company, the original proprietors of the patent. It was alleged that in selling Thomson-Houston incandescent lamps Mr. Kingsbury infringed the right of the plaintiff to the exclusive use and sale of lamps constructed on the principle of the filament patent in that colony.

The defendant did not dispute the utility of the invention, but contended that the patent was invalid on the ground of want of novelty, as the subject-matter of the invention was published in New South Wales in several different papers which were, it was alleged, circulated in the colony before March 2, 1880. In other respects the decisions of the English courts in previous years seem to have been binding in the colony, and this position was not impeached by the defendant.

His honor, Mr. Justice Manning, held that there had not been such a prior publication as to invalidate the patent, and granted to the plaintiff an injunction with costs.

College Notes.

McGILL UNIVERSITY, MONTREAL.

THIS university now provides a course of instruction of high standing and completeness, both of a theoretical and practical character, in electrical engineering at Montreal. The course extends over four years and for the first two years is essentially the same as that in mechanical engineering, including practical instruction in the use of tools, etc., in the workshops. After the preliminary mathematical and other needful branches, the remaining years are devoted principally to the practical and theoretical study of electricity. The object being to give the student a general training, as well as to inculcate those principles upon which alone he can base success in his professional career.

In electrical engineering proper, neither the theoretical nor practical sides of the subject are neglected, as appears from the following brief outline of the course of instruction, which includes: The theory, construction, calibration and use of measuring instruments. Magnetism and the design of electromagnets for special objects. The laws of induction. Electrical mechanisms, meters and arc lamps, etc. The general design and construction and testing of dynamos and motors. The distribution and transmission of electricity. Lighting systems. Electric traction. Transformers, accumulators, etc.

This department is under the direction of the Faculty of Applied Science, of which Professor Henry T. Bovey is the dean, Professor C. A. Carus-Wilson being the professor of electrical engineering.

The fine laboratories in the new buildings are being fitted up with an extensive and carefully selected collection of apparatus, chosen to represent the best types in use on this continent and in Europe. The equipment of the testing laboratories includes a very complete set of measuring instruments, comprising not only those for practical use, but standard instruments with which the correctness of the others can be ascertained. In addition, there is a variety of apparatus for special purposes, such as determining the coefficients of mutual and self-induction.

For measuring the mechanical power supplied to the dynamos and furnished by the motors there are the various forms of belt, rope and transmission dynamometers, with a very perfect form of hydraulic absorption dynamometer for checking the readings of the others.

The dynamo-room, when fully fitted up, will contain commercial and experimental dynamos and motors of the best modern types. Every convenience has been provided for varying the speed of the dynamos and in the other laboratories as well. Special facilities have been furnished for conveniently making tests, conducting investigations, etc. A peculiar and noteworthy feature is that delicate tests and experiments will be made in the Physics Building, three or four hundred feet distant from the Engineering Building, where the dynamos and engines are located, thus securing for the delicate apparatus entire freedom from any disturbing influence occasioned by the machinery. The two buildings will be connected by underground cables, by which current will be transmitted to the Physics Building for light and power, and also for experimental work in physics.

The laboratories of chemistry, mining, mechanical and civil engineering, of the other departments of applied science, are equally as well equipped with apparatus and facilities for practical and theoretical instruction.

Announcements of the different courses and other information may be had upon application to the dean of the faculty, Prof. Henry T. Bovey.

THE JOHNS HOPKINS UNIVERSITY ELECTRICAL ENGINEERING COURSE.

THE programme for 1892-93, just issued gives an outline of the course which extends through two years and includes instruction in theoretical and applied electricity, steam and hydraulic engineering, machine design, mechanics of engineering and mechanical drawing. An important feature is laboratory work, to which much attention is paid, and original investigation is especially encouraged. The instruction is given by Associate Professor Louis Duncan, Ph. D., Mr. Hermann S. Hering, M. E., Mr. Wm. S. Aldrich, M. E., and Mr. Percy Matthews.

The course is primarily intended for graduate students, who are not formally examined for admission, but are required to satisfy the instructors that they are fitted for the work. Students who have received the degree of Bachelor of Arts on completing the Mathematical-Physical group in this University, are well prepared to take up the special studies of electrical engineering. Special students may be admitted to the course after completing the studies of the preparatory year. Special students who are not ready for the regular work in electrical engineering, may be admitted to a preparatory course including the first year undergraduate course in mathematics (plane analytical geometry and differential and integral calculus), in physics, and in chemistry, and a year of drawing. These students must pass an entrance examination covering the matriculation requirements in mathematics, French or German (first division), English, United States history, and science. Near the close of the year the class will conduct a test of a central station and electric railroad and prepare a complete report on the same.

Personal.

MR. ADOLPHO ASCHOFF, of Rio Janeiro, who was here some months ago investigating telephones and electric railroads, and has done much to promote the interests of both in Brazil, has now returned as secretary to the Brazilian Commission at the Chicago Exposition. He will make his headquarters in Chicago, and proposes to prepare a creditable representation for his country.

MR. JOHN BOGART has been appointed by the Rapid Transit Commission chief engineer of the commission, and now that the Supreme Court of this State has approved the plans for the new rapid transit system of New York, he will assume his new duties at once. Mr. Bogart is well known in electrical circles. He was at one time secretary of the American Society of Civil Engineers, and later became State Engineer and Surveyor.

MR. W. C. FUCHS, E. E., has resigned his position with the Milwaukee Street Railway and has become the electrical engineer of the Cicero and Proviso Street Railway Co., Oak Park, Ill., with full charge of all their electrical work. Mr. Fuchs is a graduate of the City and Guilds of London Institute, where he studied under Profs. Ayrton, Perry and S. P. Thompson.

MR. WILLIAM H. BRYAN, M. E., late general superintendent of the Pond Engineering Company, and formerly secretary of the Heisler Electric Light Co., will in future devote his time exclusively to the practice of his profession of mechanical and electrical engineering, at 56 Turner Building, 304 North Eighth street, St. Louis. He writes that he will do no selling or contracting of any nature, but will endeavor to serve the best interests of the purchaser. Associated with Mr. Bryan are Messrs. Winthrop Bartlett, C. E., and N. W. Perkins, M. E., who are specialists in cable and electric railways, and machinery and shop design, respectively.

Letters to the Editor.

THE STRENGTH OF THE McINTIRE JOINT.

IN THE ELECTRICAL ENGINEER of June 22, Mr. McIntire claims that his joint was not given a sufficient number of twists in the tests that formed the basis of Mr. F. W. Jones' recent article on "Breaking Strains of Joints." Three twists was the number determined upon, after careful inquiry as to the usual practice in actual construction work. I hope to make further tests in the near future, and will be glad to try the McIntire joint at five twists.

MINOR M. DAVIS.

NEW YORK, July 1, 1892.

Society and Club Notes.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BY invitation of the city of Rochester, as expressed through the scientific, educational and civic organizations, the forty-first meeting of the American Association for the Advancement of Science will be held in the city of Rochester, N. Y. The official time given for the association meeting will be from August 16th to August 24th inclusive. The hotel headquarters of the association will be the Powers. The meeting will be held at the University of Rochester (corner Prince street and University avenue), where will be the offices, the hall for general sessions, and the rooms for the several sections.

For information relating to membership and papers, address F. W. Putnam, permanent secretary, Salem, Mass. For all matters relating to local arrangements, hotels, railway rates and certificates, address Professor H. L. Fairchild, local secretary, University of Rochester, Rochester, N. Y.

THE NEW YORK ELECTRICAL SOCIETY AND "SINBAD."

THE annual meeting of the New York Electrical Society, for the election of officers, reception of reports, etc., will be held on Thursday, July 14, 1892, at 7.45 p. m. sharp, at the Electric Club, 17 East 22d street. The business will be taken up at the time named without a minute's delay by the members, in order that the second part of the evening's program, which is open to all, may be carried out. Special arrangements have been concluded with the management of the Madison Square Garden, through the kindness of Mr. David Henderson, whereby the members of the society will attend the performance of the successful extravaganza "Sinbad" in the Garden Theatre at 8.15 p. m.

This opera includes a large number of brilliant spectacular effects, utilizing the projection arc lamp in a way and to an extent never before attempted. After the performance members will be at liberty to ascend the tower and to enjoy the attractions of the roof garden, which include, not only a fine concert, but some beautiful decorative uses of the electric light. The price of the coupon ticket covering the whole entertainment, and ensuring the best seats in the theatre, will be only $1.00. The invitation includes ladies as well as gentlemen, and it is hoped that there will be a large gathering of members and their friends. Applications for tickets, with remittance, must be received at the office of the secretary, Mr. Geo. H. Guy, 533 Temple Court, Beekman street, at once.

CHICAGO ELECTRICAL ASSOCIATION.

MR. W. B. SPEIR addressed the meeting on June 28, with some "Notes on Pole Line Construction," referring more particularly to the metallic circuit lines used for telephone purposes. He showed how these had changed from an almost haphazard assembling of crude parts to the carefully systemized construction which gives us the neat and lasting overhead lines of to-day. After a discussion of this paper, the association adjourned until the second Tuesday in September.

FRANKLIN EXPERIMENTAL CLUB, NEWARK, N. J.

AT a regular meeting of the Franklin Experimental Club held Tuesday, June 21, it was decided to discontinue the meetings during the summer months. The next meeting is to be held the second Tuesday in September. The laboratory and reading-room will continue to be open for the benefit of members.

Inventors' Record.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JUNE 28, 1892.

Accumulators :—

Secondary Battery, W. L. Silvey, 477,914. Filed June 15, 1891.

Claim 9 follows :

In a secondary battery a plate or element electrode consisting of a central grating of wires of aluminum, an outer covering for the central grating of a soft metal such as lead, and an active material consisting of a metallic oxide supported thereby.

Electrode for Secondary Batteries, H. G. Osborn, 478,018. Filed April 7, 1891.

Employs independent slotted receptacles and thin connecting pliable webs.

Alarms and Signals :—

Automatic Test for Burglar Alarm Systems, A. Stromberg, 477,712. Filed Mar. 17, 1892.

Pickpocket and Coat Thief Detector, J. F. Hurd, 477,940. Filed Oct. 2, 1891.

Electric Alarm, S. M. Matthews, 477,950. Filed Nov. 16, 1891.

A low-water alarm for boilers.

Conductors, Conduits and Insulators :—

Method of Insulating Electric Conductors, A. V. Abbott, 477,782. Filed Mar. 12, 1892.

An insulation composed of vitreous enamel held in place by a wrapper of organic substance, which is afterward destroyed by firing.

Insulator, F. D'A. Goold, 477,753. Filed Oct. 24, 1891.

Consists of a single strip of metal bent to form a base and two spring arms, constituting a holder for the insulator.

Electric Conductor, C. T. Snedekor, 477,787. Filed Oct. 17, 1891.

Employs a fireproof compound of calcined magnesia, china clay and silicate of soda, a coating of rubber and a final coating of the same fireproof compound.

Composite Electric Conductor, C. A. Mezger, 477,951. Filed Oct. 30, 1891.

A concentric arrangement providing means for the compact assemblage of two or more conductors in parallel and the complete insulation of each from the others,

Insulator, H. C. Wirt, 477,980. Filed Feb. 21, 1890.

An insulator having a knob at each end around which the wires are wound and a central base portion for attachment to the wall.

Dynamos and Motors :—

Dynamo Electric Machine, J. J. Wood, 477,729. Filed Dec. 1, 1891.

Employs a commutator brush yoke, having a concentric cylindrically projecting flange, an armature shaft bearing having a groove to receive the flange, and a removable fastening at the end of the bearing and overhanging the yoke for the purpose of holding the latter in the groove.

Galvanic and Thermo-Electric Batteries :—

Battery, W. A. Childs, 477,645. Filed Dec. 27, 1888.

Claim 1 follows :

In a battery a metal screw bolt or rod having a carbon head, said bolt or rod passing upward through an opening in the negative element and through the battery cover.

Lamps and Appurtenances :—

Socket for Incandescent Lamps, E. L. Smith and G. C. H. Foster, 477,786. Filed Sept 7, 1891.

Has for its object to reduce the resistance of the socket and to secure the socket screw against independent axial rotation.

Receptacle for Portable Electric Lamps, H. Molendo, 477,810. Filed April 21, 1892.

A wall or ceiling connection for portable incandescent lamps.

Electric Lamp or Conductor Support, C. Bell, 477,984. Filed March 28, 1892.

Employs an eye bolt with a threaded shank and an insulator formed of two parts having notches in the lower part for receiving the ends of the hanger.

Measurement :—

Electrical Measuring Instrument, E. Weston, reissue 11,250. Filed Feb. 5, 1892.

Claim 1 follows :

In an electrical measuring instrument a stationary coil, a coil movable in the field of said stationary coil, and a spring opposing and counterbalancing the impressed action of said movable coil, the said coils and spring being connected in circuit.

Miscellaneous :—

Electric Regulating Apparatus, J. M. Bradford, 477,637. Filed Sept. 29, 1890.

Provides automatic means for regulating and maintaining the current strength at a certain degree or at a uniform intensity.

Lightning Arrester, F. Haselwander, 477.656. Filed Oct. 2, 1891.

Employs an explosive cartridge interposed between the circuit terminals and the earth connection.

Electric Current Regulator, C. D. Sigsbee and T. S. Hayward, and F. S. Anderson, 477,708. Filed Sept. 11, 1891.

Employs a resistance device composed of conductive material and one or more perforated regulating plates of lower conductivity.

Elevator, P. Wright, 477,730. Filed May 18, 1891.

A safety device for an electric elevator consisting of a grip normally held out of action by a fragile pin, and a governor connected by a rope to the gripping lever.

Electric Telemeter, C. T. Barrett, 477,853. Filed Nov. 5, 1891.

Process of Making White Pigments, J. Blair, 477,735. Filed July 17, 1891.

An electro-chemical process of paint manufacture.

Electric Current Transformer, N. T. Wilcox, 477,879. Filed Aug. 20, 1891.

Employs a direct current generator, a direct current motor, a transformer and collecting rings to which one of the windings of the transformer is connected, a single commutator having opposite segments connected to the collecting rings and commuting the current flowing through one part of the motor.

Electric Lock, W. H. Hollar and F. S. Holmes, 477,897, Filed Feb. 3, 1 90.

Electric Lock, W. H. Hollar and F. S. Holmes, 477,898. Filed Feb. 3, 1890.

Voltaic Body Battery, W. P. Potter, 477,913. Filed April 4, 1892.

Electric Bath Apparatus, H. E. Waite, 477,975. Filed May 17, 1892.

Electrical Stop Motion for Knitting Machines, A. Beyer, 477,986. Filed Oct. 5, 1891.

Automatic Electric Change Maker and Check Receiver, T. Mangan, 478,011. Filed Sept. 26, 1891.

Electrical Organ, R. P. Strand, 478,082. Filed March 23, 1892.

Railways and Appliances :—

Electric Railway, J. W. Bates, 477,734. Filed Mar. 17, 1892.

Employs a series of posts projecting above the surface of the ground between the tracks and having side openings in which are contained the contact pulleys.

Device for Suspending Trolley Wires, J. Sachs, 477,781. Filed Oct. 28, 1891.

Conduit for Electric Railways, C. T. H. Schwieger, 478,026. Filed Sept. 16, 1891.

Employs two V-shaped conductors placed opposite one another in the same horizontal plane, and a contact device having corresponding V-shape bearing surfaces.

Switches and Cut-Outs :—

Electric Switch, H. M. Pilkington and R. S. White, 477,869. Filed Oct. 8, 1891.

Employs several switch blades movable together or independently and having a common operating handle and separate handles for operating the members separately.

Mast Arm Electric Switch, T. Dillon, 477,890 Filed Mar. 31, 1892.

Has for its object to automatically cut off the lamp current when the arm is lowered.

Telegraphs:—

Electrical Keyboard, W. E. Blodgett, 477,635. Filed Mar. 17, 1890.

Has for its object the closing of a large number of independent circuits by means of a small number of keys.

Writing Telegraph System, H. Etheridge, 477,652. Filed Sept. 10, 1890.

Enables any one subscriber to operate the receiver of the other subscribers without first calling up by a signal.

Individualizing Cut-Out for Printing Telegraphs, S. R. Linville, 477,665. Feb. 10, 1892.

Consists in short-circuiting the electromagnets controlling the type wheels by means of individualizing cut-out mechanism so that an operator may not only short-circuit the electromagnetic devices without interrupting the line, but also can restore such circuits when desired.

Phonoporic Telegraphy, C. Langdon Davies, 477,835. Filed Apr. 20, 1892.

Employs a primary circuit, including a vibrating tongue and primary coils, secondary phonopore coils, a key for opening and closing the primary circuit and devices for closing the circuit through the primary coils excluding the battery.

Telephones and Apparatus :—

Telephony, R. Hope-Jones, 477,866. Filed Sept. 17, 1891.

Has for its object the magnifying of minute vibrations in a vibratory body.

Anti-Inductive Device for Telephones, S. Pollak, 477,870. Filed Nov. 11, 1891.

Provides means whereby any one using a telephone may regulate the instrument from time to time to overcome inductive effects.

THE NEW DYNAMO OF THE DETROIT ELECTRICAL WORKS.

THE description of the new type of machines of the Detroit Electrical Works, which will be found on another page, demonstrates the care with which these machines are built; and as a result they are being rapidly introduced. Thus among the recent orders received for these machines are the following:

Times Building, Chattanooga, Tenn., two 30 K. W. generators, one 9 and one 15 K. W. motors. Bagley estate, Detroit, one 400 K. W. generator and five 9 K. W. motors, This contract also includes five freight elevators and controlling devices for motors, so that each elevator is operated by one 9 K. W. motor, which is controlled, started and stopped by means of the starting rope of the elevator, the motor only running when the elevator is in use. Detroit Dry Dock Co., two 250-light generators for lighting machine shop, boiler shop, dry dock, engine-rooms and offices. One 40 K. W. generator to furnish current for electric cranes. Also, Detroit Dry Dock Co., for boats which they are building, one 125, one 150 and one 250-light plants, complete. Detroit Foundry Equipment Co , Detroit, one 9 and one 17 K. W. motors, complete, with controlling devices, etc., for electric cranes.

THE ROSE POLYTECHNIC INSTITUTE.

THE Rose Polytechnic Institute, of Terre Haute, is one of the few well-endowed and well-equipped schools of a college grade in the United States devoted exclusively to the professional education of mechanical, electrical and civil engineers and chemists. Very special attention is devoted to electricity. It is the strongest possible evidence in favor of this school that for several years the applicants for admission have exceeded the limited number that can be admitted. Those intending to study engineering should address Rose Polytechnic Institute, Terre Haute, Ind., for catalogue.

MR. A. J. CORRIVEAU, Montreal, Can., is doing all he can to interest the public in electrical novelties and improvements. The *Star* says : "A very pretty exhibit of electrical appliances is at present shown in the *Star* window and is much admired by the passing public. The exhibit is composed of elegant electrical fixtures, brackets and lamps of brass, copper, iron and onyx. Several electric fan motors are also exhibited, some suspended from the ceiling, mounted in polished brass, and others resting on bases, with rotating fans. They are pretty little machines, which can be set on a desk, table, mantel-piece, etc., and keep a room cool. This fine exhibit was loaned by Mr. A. J. Corriveau."

TRADE NOTES AND NOVELTIES

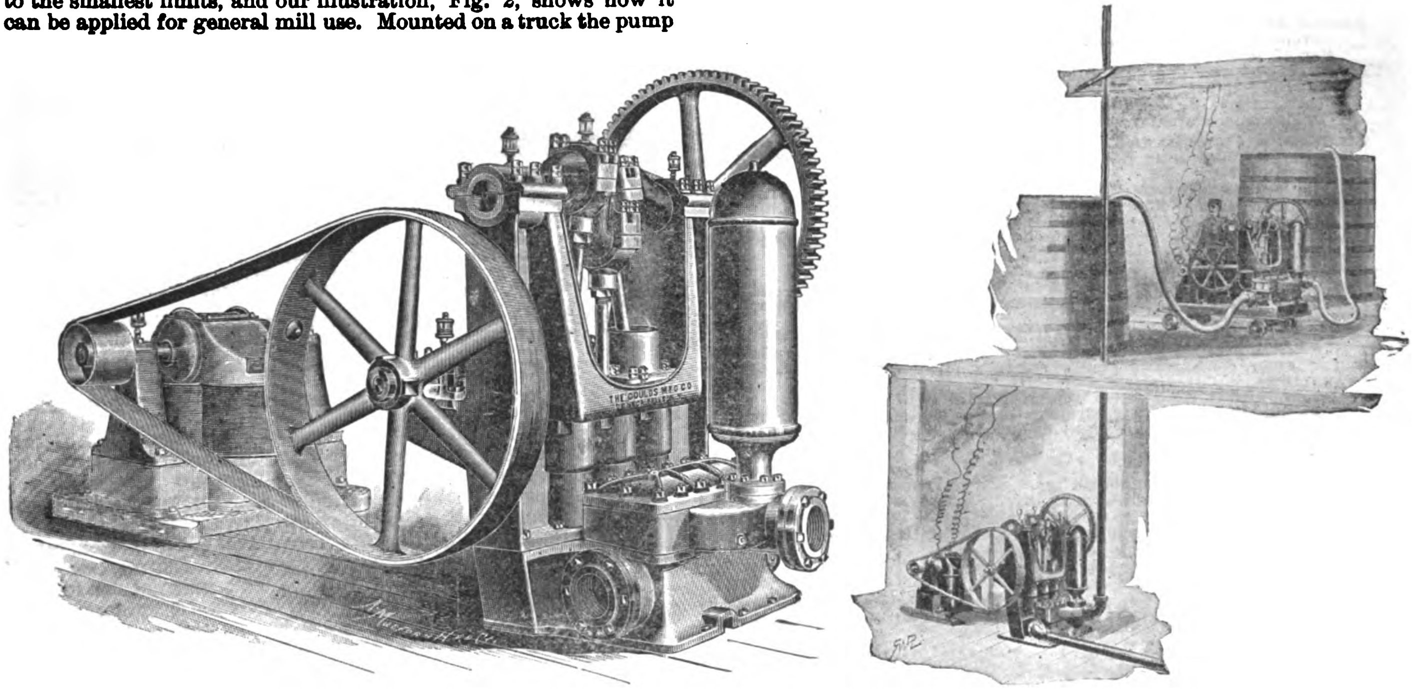
AND MECHANICAL DEPARTMENT.

Continuous advertising and continuous returns are cause and effect.

THE GOULDS TRIPLEX ELECTRIC PUMP.

Recognizing the great value of the electric motor as an auxiliary in the innumerable situations where pumps are required, the Gould's Manufacturing Company, of this city, early devoted themselves to the building of combination electric pumps for which their well-known Triplex pumps were admirably adopted on account of the smoothness of their action. One of the most generally applicable combinations of this kind is shown in the engraving, Fig. 1, which illustrates the Triplex pump driven by a belt from the pulley of an electric motor. The pinion of the pump gear is of rawhide, thus insuring noiseless operation.

The combination permits of bringing the space occupied down to the smallest limits, and our illustration, Fig. 2, shows how it can be applied for general mill use. Mounted on a truck the pump combination can be readily moved from place to place, thus making it specially convenient for tank pumping and pumping mash in breweries, etc. The motor shown in the cellar supplies a water tank used for general purposes.



The Goulds Triplex Electric Pump.

ENLARGING THE BRUSH PLANT AT GENEVA, N. Y.

Mr. C. H. Avery, the manager of the Geneva Brush Electric Light and Power Co., is about to begin extensive additions to the station and plant of that concern. The increase of floor space will be about 2,100 feet, which will be taken up by two new boilers, two 100 h. p. engines, generators for railway and stationary motor work, switchboards, etc. A large new brick smokestack with four boilers of 600 h. p. capacity is to be erected, and a new 200 h. p. compound condensing engine has been ordered, to replace the present 60 h. p. engine. Countershafting, pulleys, condensers, steam pipe, feed-water heaters, etc., are to be put in at once, to the full capacity of the plant as now designed, and the new investment will represent about $70,000.

HEAVY SALES OF BALL ENGINES.

The Ball Engine Co., Erie, Pa., report the following large shipments in the last four weeks: F. H. Leggett & Co., New York City, one 80 h. p.; Lowell M. Palmer, New York City, one 130 h. p.; H. Ward Leonard & Co., New York City, one 130 h. p.; Electric Light Co, Coulee City, Wash., one 25 h. p.; Cooley & Vater, Minneapolis, Minn., one 100 h. p.; Silver Bow Electric Co., Butte, Mont., one 150 h. p. tandem; Hotel St. Louis, Minnetonka, Minn., one 60 h. p.; Oakland Street Railway Co., Stockton, Cal., one 200 h. p. tandem; Edison General Electric Co., Joplin, Mo., one 35 h. p.; Baltimore Traction Co., Baltimore, Md., one 130 h. p.; Washington Park, Chicago, Ill., one 35 h. p.; Pittsburgh Iron & Steel Engineering Co., Pittsburgh, Pa., one 50 h. p.; Risdon Iron Works, San Francisco, Cal., one 35 h. p.; Brooklyn Cooperage Co., Brooklyn, N. Y., one 130 h. p.; Hotel Vendig, Philadelphia, Pa., one 50 h. p.; Schuylkill Electric Railway Co., Pottsville, Pa., one 300 h, p.; Rome Street Railway Co., Rome, Ga., one 130 h. p.; Duluth Street Railway Co., Duluth, Minn., one 50 h. p.; Pittsburgh Locomotive Works, Pittsburgh, Pa., one 100 h. p.; Curtis & Dean, New York City, one 80 h. p.; Risdon Iron Works, San Francisco, Cal., one 200 h. p. tandem.

THE WATERTOWN STEAM ENGINE CO.

The handsome catalogue published by this company, of Watertown, N. Y., embraces a large variety of steam engineering products, chief among which, as of interest to electric light and power companies or for isolated plants, are their automatic cut-off engines, for which are claimed the features of great simplicity, few parts, extreme durability, quick sensitiveness in meeting changes of load, freedom from variation in speed, equal efficiency at different points of cut-off, and low cost. The engines are well built and capable of severe test. The Watertown Company build, also, a line of boilers.

THE BALL ELECTRIC LIGHT COMPANY.

A **very** handsome and interesting catalogue has just been issued by the Ball Electric Light Company, of 404 West 27th street, New York City, illustrative and descriptive of their apparatus. The designs on the front and back covers, printed in blue, white and gold, are so arranged that the lamp on the front, as it hangs up, is in direct circuit with the Ball machine on the back. The effect is very pretty and pleasing. The frontispiece of the pamphlet is a fine engraving of the celebrated Ball machine, once the subject of so much animated controversy, and the first part of the contents explains the merits of the Ball system, the Ball dynamo, the Ball communtator, armature, arc lamp, reciprocating carbon, all-night lamp, long-distance series incandescent system, etc., all of which are clearly illustrated. Then follows a big batch of testimonials, and this is supplemented by a very long list of users of the Ball system, many of whom have plants that have been in constant operation for years, the plants being of all sizes from 25 lights up to several hundred.

Mr. W. Scott Sims, the torpedo inventor, has been making an inspection of the Baker submarine boat on behalf of the Bureau of Ordnance, and is reported to speak very highly of what he saw at Detroit. He says it is the first boat that has been made of the kind that will ride upon an even keel.

KIND WORDS FROM THE PACIFIC.

THE PELTON WATER WHEEL Co. of 121-123 Main street, San Francisco, in a letter of recent date, say: "Permit us to congratulate you in getting into such elegant and commodious quarters. Such a move certainly affords evidence of success and prosperity. Your patrons have also reason to congratulate themselves on your ability to furnish them with unfailing regularity, information of so much value and interest."

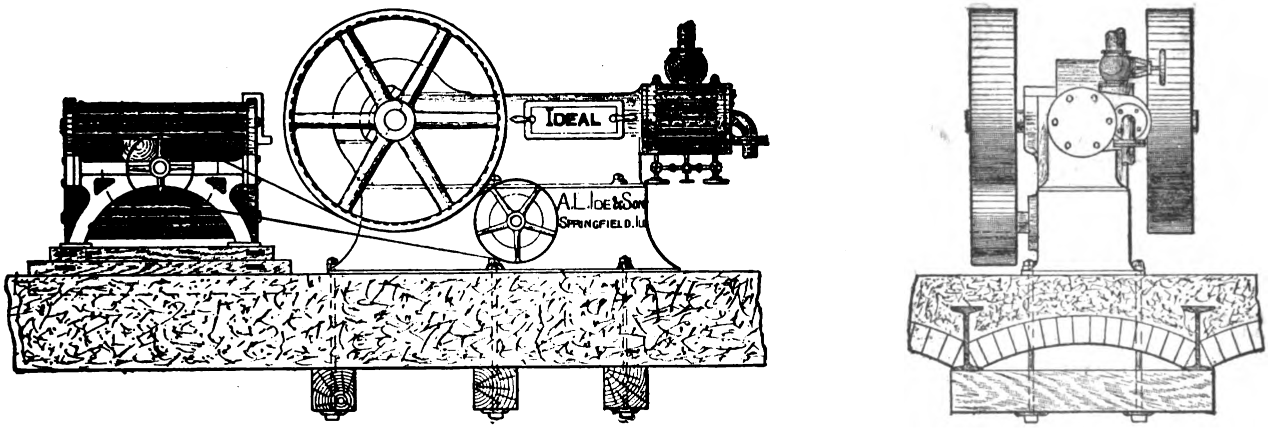
THE IDE METHOD OF DYNAMO DRIVING.

COMPACTNESS in electric central stations is desirable, not only on account of the lessened first cost of buildings and interest thereon, but also for the reason that a compact plant can be more easily supervised and maintained in good condition.

In order to reduce the space required for the engine and dynamo within as small a compass as possible, Messrs. A. L. Ide & Son, the well-known engine builders of Springfield, Ill., recently designed a method of power transmission which will be readily understood by referring to the accompanying engravings, Figs. 1 and 2, which represent respectively a side and end elevation of the plan adopted.

As will be seen, it consists of a pulley supported by a stud, which is secured to the base of the engine and requires no additional foundation or fixtures. On account of the small space required, it is especially adapted where space is limited. Two dynamos may be driven from one engine by placing a pulley on each side of the base, and either dynamo may be stopped or started, without interfering with the operation of the other machine, by sliding the dynamo on the base so as to bring the belt in contact with the lower surface of the engine pulley.

Messrs. Ide & Son have recently installed one of their 8 x 10 35 h. p. "Ideal" engines with this transmitting device driving a Thomson-Houston 250-light incandescent dynamo, for lighting the Keeley Brewing Co.'s plant, Chicago, Ill. The engine and dynamo are placed on the floor, which is composed of eye-beams or brick arches, as shown in the engravings, having no foundation or support. The engine runs at 360 revolutions per minute, and is so perfectly balanced that there is no perceptible vibration of the floor or building.



FIGS. 1 AND 2.—THE IDE METHOD OF DYNAMO DRIVING.

NEW BILLINGS & SPENCER TOOLS.

THE accompanying illustrations show two of the latest productions in small appliances of the Billings & Spencer Co., of Hartford, Conn. Fig. 1 is what is what is known as the Billings wire cutter, a device which will be appreciated by any one connected with electrical industries. It is drop forged from the best tool steel, and provided with four cutting edges on the rim, and two which are enclosed. It also has an adjustable gauge so that wire can be cut accurately to any length. The workmanship is of the same high quality which characterizes all the appliances made by the Billings & Spencer Co. The total length of the tool is ten inches.

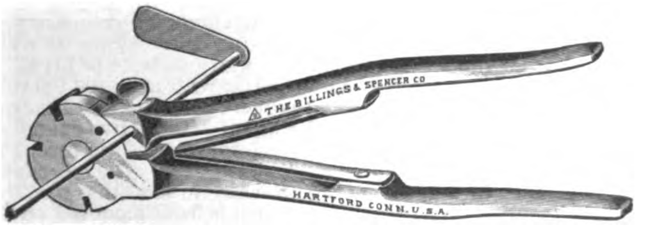


FIG. 1.—THE BILLINGS WIRE CUTTER.

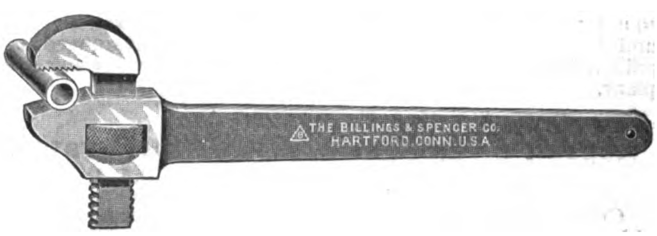


FIG. 2.—THE BILLINGS PIPE WRENCH.

Fig. 2 represents the Billings pipe wrench. The jaws of this wrench are drop forged of the best tool steel, and the handles of the best grade of machinery steel. This wrench offers many advantages, being simple in design with few parts, and characterized by the best workmanship and finish. A special feature is found in the fact that no matter how large or small the size of pipe for which it is adjusted, the angle of the jaws always remains the same. The total length is 14 inches, and is made to take pipe from ¼ inch to 1½ inches.

WARREN WEBSTER & CO.

WARREN WEBSTER & Co., manufacturers of the Webster vacuum feed water heater and purifier, 491 N. Third street, Philadelphia, Pa., during the past few weeks have booked the follow, ing orders: Cleveland Axle Manufacturing Co., Cleve land, Ohio-one 250 h. p. vacuum heater; Edison Light & Power Co., San Francisco, Cal., one 1,500 h. p. vacuum heater; Armour Packing Co., Kansas City, Mo., one 1,500 h. p. vacuum heater, 3d order; Ostrander Fire Brick Co., Ostrander, N. J., one 150 h. p. vacuum heater; Standard Kiln Dried Lumber Co., Norfolk, Va., one 500 h. p. vacuum heater; Lowenberg Knitting Co., Norfolk, Va., one 150 h. p. vacuum heater; Armour Industrial School, Chicago, Ill., one 500 h. p. vacuum heater; American Tube & Iron Co., Middletown, Pa., one 1,500 h. p. vaccuum heater; Central Iron Works, Harrisburg, Pa., one 1,000 h. p. vacuum heater; Illinois Steel Co., Milwaukee, Wis., one 1,500 h. p. vacuum heater: Joliet Enterprise Co., Joliet, Ill., one 1,500 h. p. vacuum heater; Standard Iron Co., Bridgeport, Ohio, one 750 h. p. vacuum heater, 2d order; Hydraulic Machine Co., Pittsburgh, Pa., one 100 h. p. vacuum heater; Asbury Park Electric Light & Power Co., Asbury Park, N. J., one 600 h. p. vacuum heater; St. Augustine Gas & Electric Light Co., St. Augustine, Fla., one 40 h. p. vacuum heater; Allentown Gas Co., Allentown, Pa., one 40 h. p. vacuum heater; Cleveland Rolling Mill Co., Cleveland, Ohio, one 3,000 h. p. vacuum heater, 5th order; W. F. & F. C. Sayles, Saylesville, R. I., one 1,800 h. p vacuum heater, 3d order; Cudahy Packing Co., S. Omaha, Neb., one 1,500 h. p. vacuum heater; Anhauser-Busch Brewing Association, St. Louis, Mo., one 1,500 h. p. vacuum heater; Republic Iron Works, Pittsburgh, Pa., one 1,500 h. p. vacuum heater; Edison Illuminating Co., Detroit, Mich., one 1,500 h. p. vacuum heater.

They have also booked orders from the following parties for the Williames vacuum system of steam heating, during the past few weeks: Royal Baking Powder Co., New York; Basch & Greenfield, Newark, N. J.; Eureka Fire Hose Co., Brooklyn, N. Y.; Alsip Brick Co., Chicago, Ill.; Lowenberg Knitting Co., Norfolk, Va.;

Armour Industrial School, Chicago, Ill.; Ostrander Fire Brick Co., Ostrander, N. J.; Brunswick, Balke-Collender Co., Chicago, Ill.; De La Vergne Refrigerating Co., New York.

They furnish a descriptive catalogue, and send a representative to any part of the United States at their expense, to examine plants and to explain to intending purchasers, |the advantages to be gained by adopting their system in connection with any steam plant.

MESSRS. SWINBURNE & CO. AT THE CRYSTAL PALACE ELECTRICAL EXHIBITION.

ONE of the most interesting exhibits at this exhibition is that of Messrs. Swinburne & Co., of Teddington, who show a transformer, giving nominally 130,000 volts designed for commereial use on cables. In order to test a cable of, say, 0.5 microfarad, under 50,000 volts, with a frequency of 100, a current of 12½ amperes must be available; 50,000 volts and 12.5 amperes require a 625 kilowatt dynamo. A large adjustable choking coil, however, takes or gives nearly the whole 12½ amperes. The dynamo and step-up transformer then supply quite a small current. Messrs. Swinburne & Co. are supplying a large testing plant of this kind to one of the leading cable makers, for testing a mile of cable at one time under high pressure. Fig. 1, shows a low-pressure transformer, as employed in electric welding and similar work.

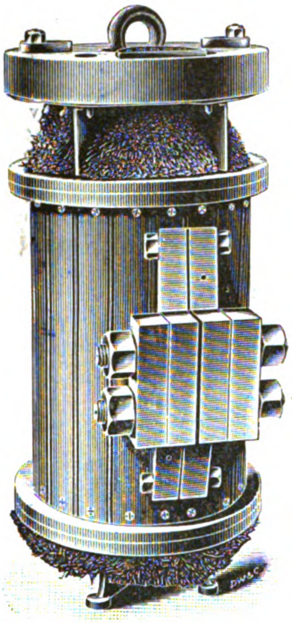


FIG. 1.

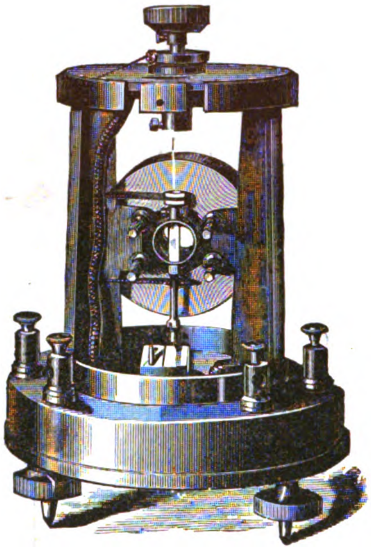


FIG. 3.

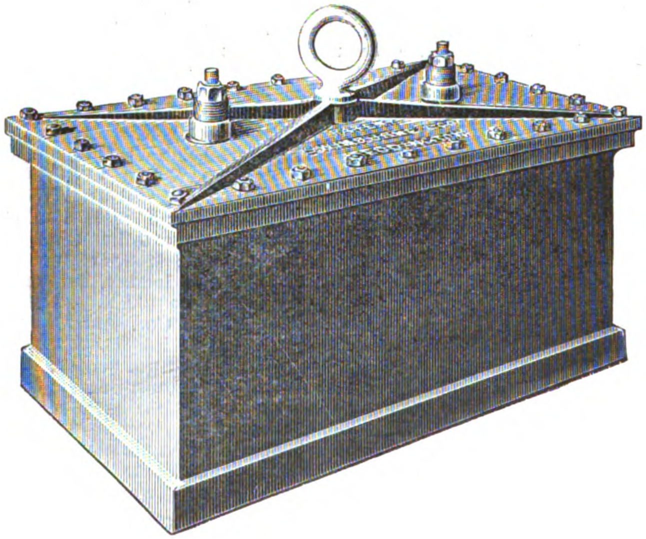


FIG. 2.

Several alternate-current condensers, Fig. 2, are also exhibited. One of these is designed for 130,000 volts for performing experiments with the high-pressure transformer for exhibition purposes. Among laboratory instruments is shown a non-inductive wattmeter, Fig. 3, designed to give accurate readings in such work as measuring power absorbed by iron in transformers. It is a dynamometer so designed that the self-induction errors are quite inappreciable. Another form of laboratory instrument for similar purposes is illustrated in Fig. 4. This is a direct-reading electrostatic wattmeter. This instrument can be used either as a wattmeter or as a voltmeter. The particular instruments exhibited were made for some interesting researches on power measurements, on which Dr. Fleming has been engaged. The Bourne form of Thomson reflecting galvanometer, Fig. 5, is designed to fulfil special requirements. The moving system consists of two vertical needles, so that the instrument is truly astatic, and is not affected by external fields.

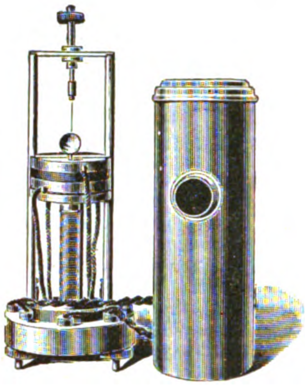


FIG. 4.

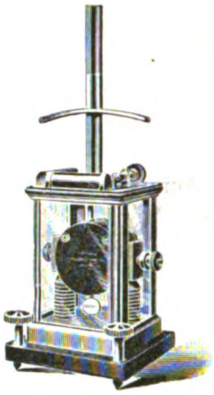


FIG. 5.

Messrs. Swinburne also exhibit a resistance box shown in Fig. 6, which differs from the ordinary form in being worked by switches, instead of plugs. The makers hold that the dial form of bridge with many coils, and a small but constant number of contacts, is more accurate than a plug with fewer coils, and a large and varying number of contacts. This form of bridge box is, of course, much quicker to use. An object of interest is a reflecting moving coil galvanometer compactly arranged in a small brass case, and having automatic gear which grips the moving system when the galvanometer is lifted. A voltmeter is also shown for measuring currents up to 100,000 volts. This instrument is on the co-axial cylinder principle, and the cylinders are immersed in heavy insulating oil. The active cylinder is connected to one terminal, the wire being carried up through a little glass tube till it is quite clear of the case. The mechanism and the other two cylinders are attached to the other terminal, and are mounted on a glass plate, which is itself mounted on corrugated ebonite pillars. The striking and creeping distances are thus very great.

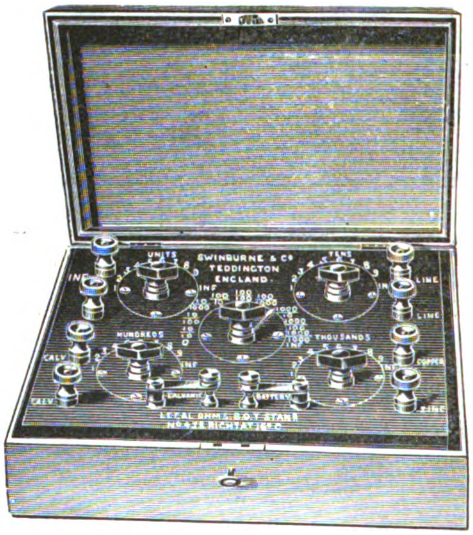


FIG. 6.

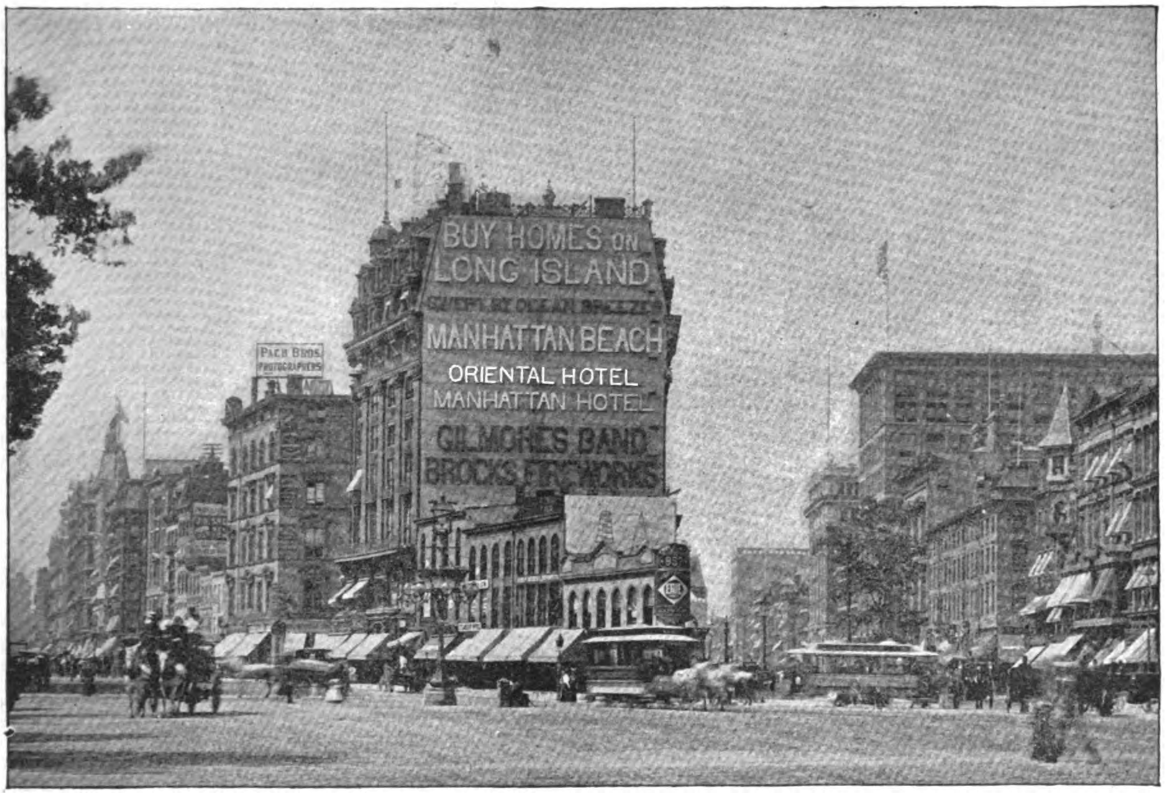
THE BALL ENGINE CO., Erie, Pa., have recently shipped to the Westminster & Vancouver Tramway Co., Vancouver, B. C., three 150 h. p. engines.

THE CORBIN ILLUMINATED ADVERTISEMENT ON WEST TWENTY-THIRD STREET, NEW YORK.

THE beautiful exhibit at Madison Square Garden, during the recent, Actors' Fund Fair, as illustrated in THE ELECTRICAL ENGINEER, of the novel developments in electric lighting by means of new small lamps, formed the initiative and experimental effort on a grand scale of a new department of the Edison General Electric Company—the Sign and Decorative Lamp Department.

The adaptability of the electric incandescent light to ornamental sign work was considered as fully proved by the success encountered at the Actors' Fund Fair, and the president of the Long Island R. R., Mr. Corbin, while viewing the many pretty effects obtained, decided to have a sign of his own, and commissioned the new department to realize his ideas.

On the corner block on 23d street, formed by the junction of Broadway and Fifth avenue, stands a small building behind which rises a huge overtowering construction nine stories high exposing a plentiful surface of blank wall over the top of its dwarf neighbors. This surface sixty feet wide by sixty-eight feet high has for the past few evenings been the study of the eyes of everybody coming down Broadway or Fifth avenue or walking East or West along 23d street. Upon the surface of this wall is erected perhaps the largest illuminated sign in the world, and certainly the largest and most conspicuous electrically illuminated sign.



THE CORBIN ILLUMINATED ADVERTISEMENT ON WEST TWENTY-THIRD STREET.

By means of this sign, Mr. Corbin brings, on these hot days, to the attention of a sweltering public the fact that the Coney Island or the well-to-do Manhattan Beach, is swept by ocean breezes, and emphasizes the various other special attractions to be found on Long Island.

In this sign, there are one hundred and seven letters, some six feet, some four feet and some three feet high, each one of which is, in reality, a box of galvanized iron. In the interior of these boxes arranged in the outline of the letters are a number of small Edison porcelain series plug cut-outs which are here used as lamp receptacles. At the lower end of each letter is a small sliding door, giving access to a plug cut-out which serves to protect the lamps in that letter. Each letter is suspended, and clasped top and bottom to two iron rods formed of strong steam piping which are securely attached to the wall by expansion bolts.

The illumination of the sign is obtained by the use of no less than 1,457—16 c. p. Edison lamps of different colors—white, frosted, red, blue and green. The current is taken from the mains of the Edison Electric Illuminating Co. There are seven sentences, each of which is on a separate and distinct circuit controlled by a lever switch. The switches are arranged temporarily on a rough wooden frame, and as the primary object of the sign is to keep the different sentences constantly appearing and vanishing, the operator is in a state of activity from dusk untill eleven o'clock at night, when all the circuits are opened and the performance ends. It is a strange fact, but true, that so long as the changes are being rung, the public is attracted and stands agape watching the sign, but as soon as the whole seven sentences are lighted and allowed to remain so, the people move on their way and the crowd disperses; 5,040 changes can be rung on these seven sentences.

From the switchboard, along the roof of the smaller building, the line is led to the base of the wall, whence the different wires run up to their respective sentences.

At the end of each line is a small platform, and between each line a long rod of bicycle steel, fastened securely to the wall, as are the letter supports, by expansion bolts. A flying ladder 8 feet long, with small wheels, fits top and bottom to two of these rods and enables the attendant to run himself along each line and replace any broken or burnt-out lamps or blown fuses, in a very few minutes. As an additional protection to the wires outside, they are run through conduit tubes thoroughly taped at their junctures, and are carried up the wall on porcelain insulators.

The great difficulty with this sign, as in the case of all outside electric lighting work, lay in preventing the deleterious effects of rain and moisture. This has been overcome by fastening to the galvanized iron box letter covers, over each hole through which the lamps are thrust into the receptacles, small pent-houses of iron which project out over the lamps, and carry off the rain, without interfering in any way with the effect of the sign. Any rain which might collect on the lamp surface is prevented from running down into the receptacle by a small projecting brass ring fastened to the outside of the lamp near the screw shell.

Each sentence is painted a different color, so that during the day the only thing lacking is the brilliancy of the illumination.

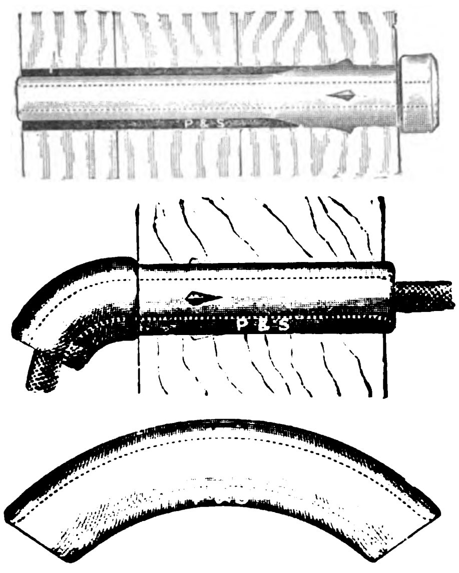
The entire work was completed in about fifty days. It was designed by and constructed under the supervision of Mr. F. R. Upton, Mr. A. D. Page and Mr. McAllister of the Lamp Works of the Edison General Electric Co.; Mr. Corbin having practically given them carte blanche.

This illuminated sign is not only a commercial success, but when all the lamps are lighted is really a thing of glory. Its splendor is visible from far away up town, and its glow on the sky can easily be seen from the East and North rivers.

MR. NEWTON L. SCHLOSS.—Increasing demands for the well-known Ries regulating socket have necessitated an increase of the selling staff, and to further the interests of their fast increasing trade, the Ries Electric Specialty Co. have secured as general sales agent for New York and the New England States Mr. Newton L. Schloss, formerly of New York, and well known in electrical circles. All will wish him continued success, and the company are to be complimented on securing his services.

PASS & SEYMOUR WINDOW TUBES AND AWNING INSULATORS.

A new catalogue has just been brought out by Pass & Seymour of Syracuse, N. Y., manufacturers of the famous Syracuse china, and in it are mentioned a number of electrical novelties and specialties in the porcelain line. Three of the minor pieces are illustrated herewith. Fig. 1 shows the new "Window Tube" intended for use where wires enter a building through windows or doors. They require a much smaller hole than the ordinary glass floor insulator now generally used, and are, it is said both better and cheaper than glass or rubber tubing. Fig. 2 shows another form of the tube, with a curved end to prevent any water entering through the tubes and complying with the insurance rule requiring a "water loop" in the line. Fig. 3 shows their "Awning Insulator," for use where wires pass awnings or over cornices or around the corners of buildings, as they give perfect protection against abrasion of the insulation. As will be seen, the insulator is very strong and is in no danger of breakage.



FIGS. 1, 2, and 3.—PASS & SEYMOUR INSULATORS.

ELECTRIC MINING IN UTAH.

MR. R. M. JONES, of Salt Lake City, Utah, has put an electric mining plant in at the Reed & Benson mine, owned by Reed & Goodspeed of Boston, and located at the head of the Big Cottonwood Cañon. The plant consists of a water power generating station with one 15 kilowatt Edison generator, from which current is transmitted three miles up into the mining district to the face of the tunnel; thence about 1¼ miles in the mine where current is supplied at 500 volts for lighting and ventilation. Mr. Jones has also supplied a rotary diamond drill of his own devising, which, he says, has exceeded in rapidity and ease of operation any other that has been tried. He has also just received another which is to go in the same mine.

NEW ENGLAND NOTES.

THE WRIGHT ELECTRICAL ENGINEERING COMPANY, of Boston, are installing the new plant of the Economic Electric Light, Heat and Power Company, at Augusta, Me. The building will be 80 feet by 42 feet, and will contain at present a 125 h. p. compound condensing Westinghouse engine, one 72 inch return tubular boiler, and two 500-light direct incandescent dynamos. The station is being built large enough for double the present capacity, and is conveniently situated on the Kennebec River, with good water and coal privileges, and ample space for future increase. Mr. C. H. Herrick, manager of the Wright Company, is on the ground himself, making all necessary plans, and looking after the construction work.

THE BOSTON BRAID MANUFACTURING CO., of Boston, the well-known manufacturers of silk braid for the filaments of incandescent lamps, have removed to much larger quarters to accommodate their growing trade, namely, from No. 28 to No. 27 Beach street, where they will continue to manufacture the same line of goods. Mr. Fiedler, the manager of the company, will be glad to see his friends at the new address.

THE ELECTRIC GAS LIGHTING CO., of Boston, are calling attention to the marvelous success of the Samson battery when used to make sparks for igniting the gas in the cylinders of gas engines, and have received some of the strongest kind of endorsements of its success in this line. The Regan vapor engine requires 125 sparks a minute, and yet with only six Samson cells and a 10-inch spark coil, the manufacturers of the engine state that they can run the engine from six to nine months without renewing the battery. Five manufacturers of gas engines in San Francisco have united in giving an unreserved testimony in favor of the Samson cell for this purpose, and state that they had never been able to use batteries successfully until they tried the Samson; now they use no other, and recommended it to all users in this line. Truly, the Samson battery is well named. Battery users should send to the Electric Gas Lighting Company for their latest circular relating to its application for gas engines. Col. Burnham has just returned from a long business trip in the West, and is now enjoying much more robust health.

THE ASHTON VALVE COMPANY, 271 Franklin street, Boston, announce that they have bought the entire plant, material and business of the Boston Steam Gage Company, together with a series of valuable patents and have consolidated the businesses. They have secured the services of the former manager of the business, Mr. H. L. Willard, long and favorably known to the trade. They will manufacture all classes of steam pressure and vacuum gauges, hydraulic gauges, water pressure and ammonia gauges and all similar instruments used in connection with steam plants, being more particularly the sole manufacturers of the Boston patent steam gauge. The reputation gained by nearly twenty years of experience in the manufacture of safety valves, and the widely recognized quality of the product of the Ashton Valve Co. will be the only guarantee needed for the quality of the goods put upon the market.

THE SUFFOLK ELECTRIC COMPANY, of Boston, has been incorporated under the laws of Maine, with a capital of $300,000, with the following gentlemen as officers: A. W. Reynolds, president; A. W. Rounds, treasurer and manager; and H. W. Body, A. C. Davies and Joseph Bennett as directors. The Suffolk Company will manufacture the Russell arc lamp, which has already attained a wide reputation, and which is the only lamp on the market using a disc form of carbon, but in addition will manufacture a new lamp, having a single pair of pencil carbons, which will nevertheless burn fifteen hours on a 10-ampere circuit, without any change of carbons. Both these forms of lamps will be ready for the market in a very short time, and the company in issuing its circular print a number of very warm testimonials as to the excellent service which has been given by the Russell lamp wherever used.

THE GOULD AND WATSON CO., of Boston, who have been long and favorably known to the electrical trade as dealers in mica, have issued a circular stating that they have disposed of their entire mica stock and the good-will of the business to the American Mica Company, who will in future conduct the main business in all its branches. Mr. George B. Watson, the former treasurer of the company, will be general manager of the new company, a sufficient guarantee that the business will be conducted with the best of care, that the interests of customers will be carefully attended to, and that the first quality of material will be furnished them at the lowest prices. The headquarters of the American Mica Company will be at Room 62, 620 Atlantic avenue, Boston.

THE AMERICAN ELECTRICAL WORKS, of Providence, R. I., inspired with the feeling of true patriotism, and remembering their numerous friends all over the country, have sent out once more their welcome 4th of July token of good fellowship—this year in the shape of a neat little miniature of the "Star-spangled Banner," with the good wish that the day might be an enjoyable one to us all. It came just in good time, and our thanks are due this enterprising firm for another very pretty decoration for the walls of the editorial sanctum. We reciprocate the good wishes, and hope that 1892 may be a banner year in the history of the American Electrical Works.

CLAFLIN AND KIMBALL, of Boston, have incorporated under the laws of Massachussetts, with a capital of $135,000, as "Claflin and Kimball, Incorporated." The officers of the new company are as follows: Adams D. Claflin, president; Marcus M. Kimball, treasurer; and George Walker, clerk. This company will continue to act as general selling agents for the Mather Electric Company and the Perkins Electric Light Company, and will also continue as electrical engineers and contractors.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

VOL. XIV. JULY 20, 1892. No. 220.

NEW ELECTRIC CRANES AT THE BRUSH ELECTRIC CO.'S WORKS.

BY

Fred A. Scheffler

THE application of electric motors to traveling cranes is assuming such proportions that this class of work can fairly be said to be a business which should require careful attention to the details in the construction both of the motor and its attachments, as well as the mechanical design of the crane itself. The latter we can leave to the crane manufacturers to take care of, and several firms have already shown great engineering skill in such designs.

A single motor crane has almost as many disadvantages in its operation and construction as the old-fashioned crane operated with a wire rope, or the improvement on it—a square shaft. Either of these three methods of operation can only be utilized by introducing a complication of double-friction clutches for reverse motion and consequent double gearing, and these are again multiplied for the required movements, provided the crane is desired to be operated by power in more than one of the three directions necessary to a traveling crane—longitudinal, transverse and hoist movements. Therefore there are usually no less than six, and sometimes many more, clutches to be operated and repaired, in the old-fashioned (this term is perfectly proper at the present writing) cranes.

Electric motors have revolutionized the crane business, and to-day the three-motor cranes (one motor for each motion) are in demand in preference to all other methods, for any kind of work whatsoever. Some work even requires an extra motor for hoisting light loads, where the main hoist is not rapid enough except for heavy loads,

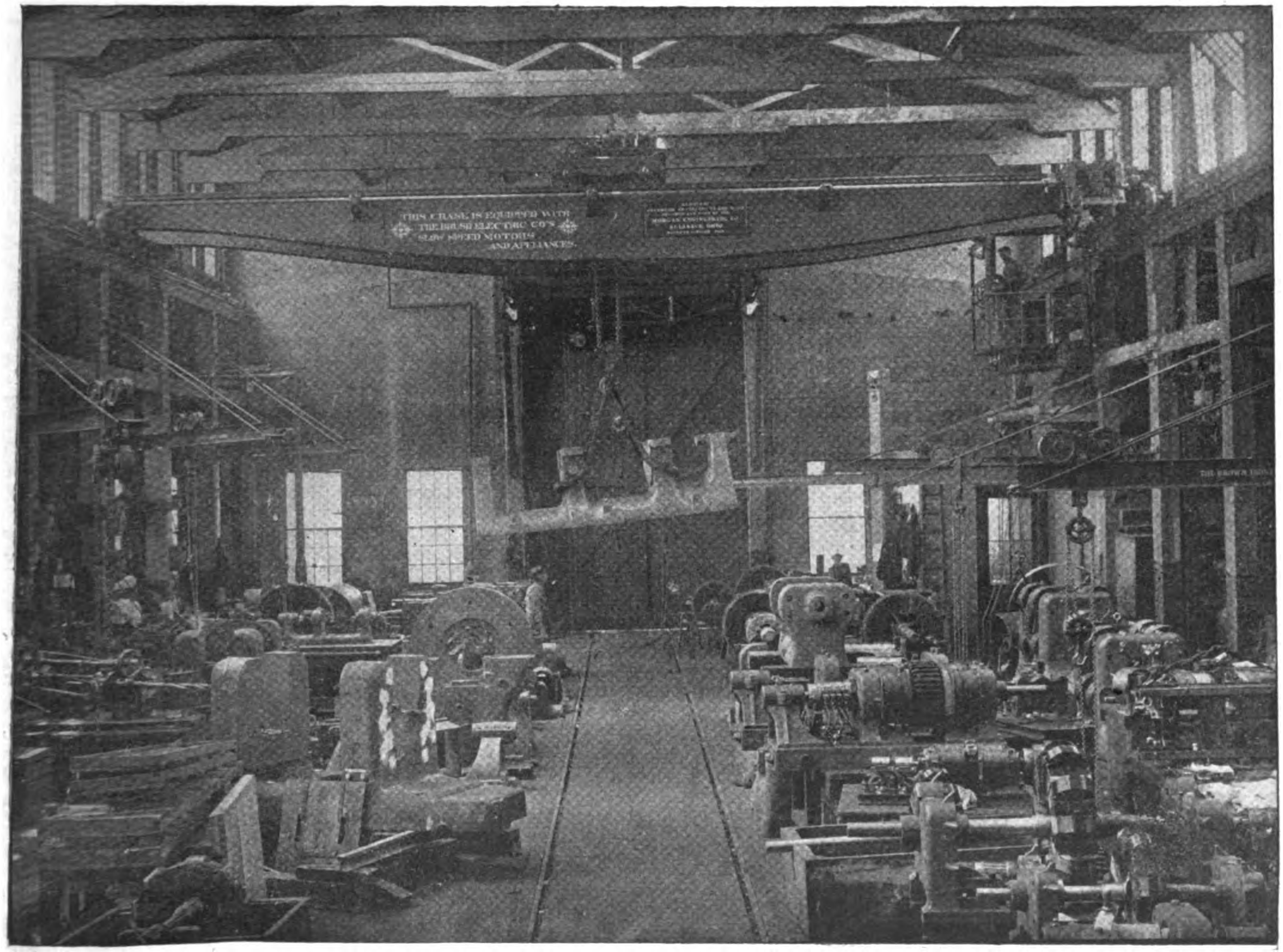


FIG. 1.—TRAVELING CRANE IN THE BRUSH ELECTRIC CO.'S ERECTING SHOP.

The custom has generally been to use the ordinary high-speed motors and by a system of a train of gears reduce the speed to a few revolutions per minute. In general the reduction has been from a belt speed of from 3,600 to 4,000 feet per minute to 150 feet of longitudinal travel and to 15 feet for hoist. The gearing necessary to do this is, therefore, considerable, and consequently the loss by friction in the gears and bearings must be very large. The writer has a decided objection to using gearing in any form where the work can possibly be accomplished by some other means, and when it was found necessary to provide the Brush Electric Company's new erecting-room at Cleveland with a traveling crane, the opportunity for developing a motor which would be specially applicable to such purposes, and others where comparatively slow speed is required, presented itself.

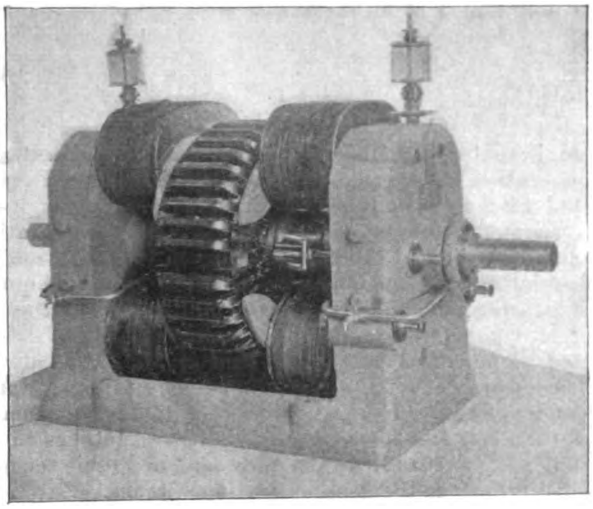


FIG. 2.—10 H. P. SLOW SPEED BRUSH MOTOR.

Fig. 2 shows the motor used for this purpose, which at 200 revolutions gives 10 h. p. with an efficiency equal to that of a high-speed motor. The crane which is shown in Fig. 1 is equipped with two 10 h. p. motors of this type (longitudinal and hoist) and one 5 h. p. for transverse movement of the trolley. The latter motor only makes 100 revolutions when developing 5 h. p. Each motor is furnished with a standard in the cage on which is mounted a hand wheel operating the rheostat for changing the speed and the reversing switch. The crane is operated on a 500-volt circuit, and can be inspected at any time by parties interested.

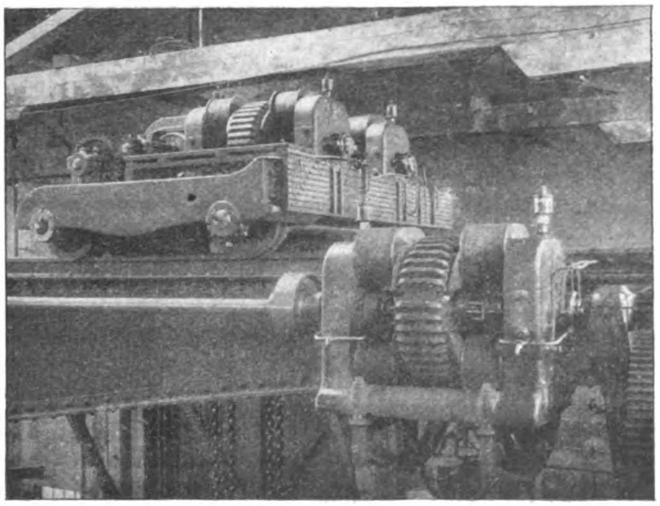


FIG. 3.—SLOW SPEED MOTORS ON CRANE.

Fig. 3 is an enlarged view showing the three motors in their respective positions for longitudinal, transverse and hoist movements. The motors are self-contained, and deviate from the usual construction of the Brush incandescent dynamos and motors in that the commutator is enclosed between the upright pieces forming the supports for the magnets, and there is therefore no out-end bearing required. This reduces the space occupied by the motor very materially. The brush holders are fixed, the motors being so proportioned that the position of the brushes on the commutator will not have to be changed when the load is varied, no rocker, therefore, being required. Carbon brushes are employed, and there is practically no sparking whatever at the commutator. The motor for longitudinal travel, as seen in the cut, is coupled directly to the shaft running across the bridge, each end of which shaft is furnished with a pinion gearing directly to the truck wheels carrying the crane so that there is no possibility of the crane being thrown out of its proper position on the track when traveling. The power for hoisting is transmitted by a simple worm and wheel, the latter being keyed to the hoisting drum shaft and meshing in the worm on the end of the motor shaft, making the reduction in speed with only one set of wheels.

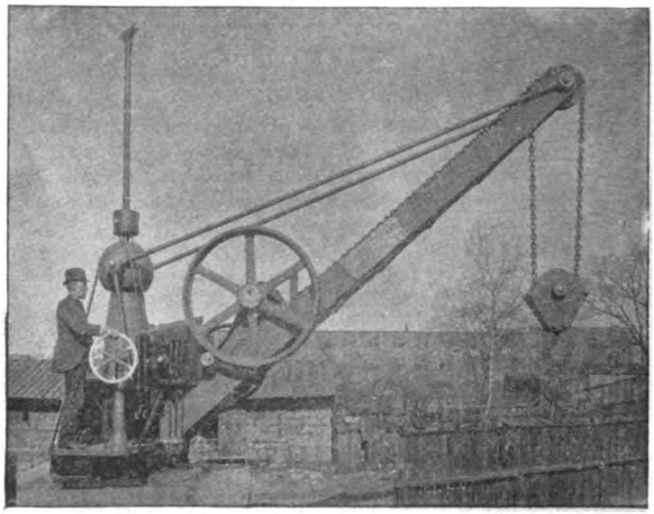


FIG. 4.—15 TON PILLAR CRANE, EQUIPPED WITH 10 H. P. MOTOR.

These motors are especially applicable also to pillar crane work, and Fig. 4 shows a 15-ton crane of this type fitted with a 10 h. p. motor running at 200 revolutions, which gears directly to the intermediate shaft, and from that to the drum shaft. The crane is fitted with the same hand-wheel contrivance and rheostat and reversing lever, and is operated on the same circuit as the traveling crane. The motor and the electrical appliances are carefully boxed in to protect them from the weather, so that the crane can be used for out-of-door work when desired.

While the above description showing the application of the slow-speed motors only applies to crane work, they are extremely well adapted for pump, elevator, general shop work, and all places where stationary motors are desired.

LIGHTNING ARRESTERS.

WE have received an inquiry as to the existence of any lightning arrester based on the principle of a discharge through vacuum in glass bulbs or tubes, and will be glad to hear from our readers who may possess information on the subject.

THEORETICAL ELEMENTS OF ELECTRO-DYNAMIC MACHINERY—IX.[1]

BY

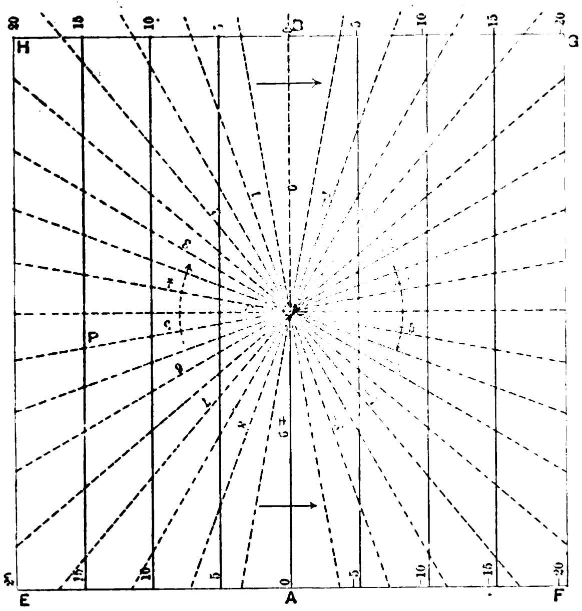
A. E. Kennelly

STRESS DISTRIBUTION.

The flux in a magnetic circuit is accompanied by a condition of stress. In a perfect fluid at rest, the stress at any point is equal in all directions. Magnetic stress, however, varies from a negative value or tension in the direction of the flux, to a positive value or pressure in the perpendicular plane. Assuming then that ether is a perfect fluid, this observed condition is an argument for the existence in it of motion for which flux is the origin, associate, or result. This is the basis of Maxwell's theory of molecular vortices.

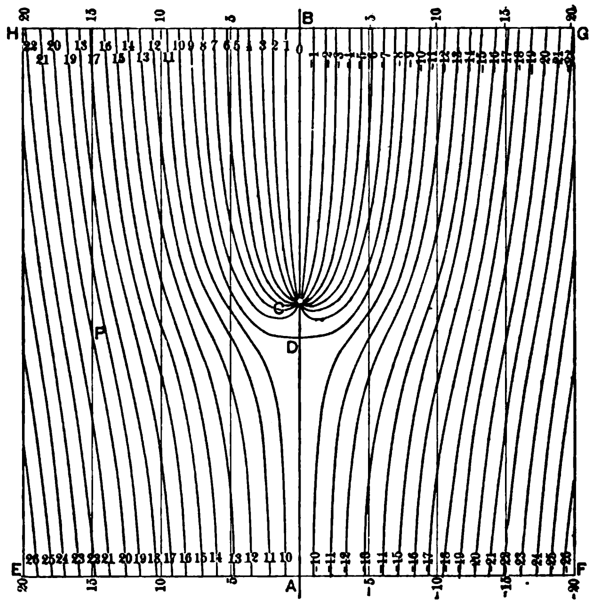
Whatever may be the ultimate cause of this stress, all the observed moving forces that are exerted between currents or magnets may be attributed to its existence. If we consider any point in the magnetic circuit where the intensity is B, the stress will be represented by a pressure of $\frac{B^2}{8\pi}$ dynes per square centimetre in all directions, like a simple fluid pressure, with a superimposed tension of $\frac{B^2}{4\pi}$ dynes per square centimetre in the direction of B. The resultant pull in this direction will therefore be a tension of $\frac{B^2}{8\pi}$, and, broadly speaking, the lines of flux tend to shorten themselves, while repelling each other sidewise. This is the fundamental moving power in nearly all electrodynamic machines.

Strictly speaking, all substances appear to have some capability for magnetization. The effect is ordinarily so feeble that it can only be discovered by placing two substances in a powerful flux, so that the difference of their magnetic properties may enable them to exert a relative displacement. Excluding therefore the magnetic metals and their principal chemical derivatives, matter is apparently unaffected by permeating magnetic flux, and the stress may be said to exert as negligibly little disturbing influence upon the substances in its path, as hydrostatic stress might effect upon a sponge immersed in the cylinder of a hydraulic press.



SCALE, ⅜ FULL SIZE.
FIG. 18.

Considering the case of a long straight wire at rest, far removed from all magnetomotive forces, it is evident that the stress set up when a current passes through the wire cannot tend to displace it bodily, for we know that the flux, and consequently the stress, is symmetrically distributed in concentric cylinders round the axis. There will be a uniform pressure on the surface of the wire tending to compress it and reduce its diameter, keeping the axis at rest. But any flux from neighboring magnetomotive forces, or from portions of its own circuit, not in its own straight line, will in general disturb this symmetry, and give the wire a tendency to move.



SCALE, ⅜ FULL SIZE.
FIG. 19.

This pressure in the case of a wire of radius r carrying a current c will be $\frac{2c^2}{\pi r^3}$ dynes per cubic centimetre of the wire's substance. Thus a straight wire carrying 30 amperes and having a radius of one millimetre would have a pressure exerted on its surface due to the stress from its own flux of $\frac{2 \times 3 \times 3}{3.1416 \times (0.1)^3} = \frac{18,000}{3.1416} = 5,730$ dynes per cubic centimetre of its volume, and a small element in or near the surface of any shape occupying $\frac{1}{1000}$th of a cubic centimetre would be forced towards the axis by a pull of 5.73 dynes. Three-fourths of this stress is due in a round wire to side pressure and one-fourth to the tension along flux paths encircling the surface.

Fig. 18 represents two systems of potential. One, indicated by the parallel straight lines, belongs to a uniform intensity. The other, shown in radial dotted lines, is due to a long, straight, current-carrying wire appearing in section at C. If the parallel lines are one centimetre apart $B = 5$ in the first system over the 64 square centimetres of space included in the diagram. Also since $4\pi c = 18$, the current establishing the second system has a strength of 1.432 or 14.32 amperes.

For numerical convenience, the cyclic elevation of potential round the wire is indicated as taking place at the line A O B in the surface of zero potential for the first system. The arrows indicate the respective directions of the flux in the two systems and are assumed to lie in the plane of the paper. The current c must therefore be flowing down the wire from the observer, since the nut on a right-handed screw rotating with the arrows would move in that direction.

If these two systems coexist, their effects will necessarily be combined. Fig. 19 gives the resulting system, the curves representing the sections in the plane perpendicular to the wire, of the equipotential surfaces surrounding a current of 14.32 amperes in a uniform prime intensity of 5. The faint straight lines indicate the surfaces of the first system. The point P for example, which stood in Fig. 18 on the surfaces of + 15 and + 5, now resides on that of + 20. The general effect is a crowding of the contours between B and C, with a more sparse distribution between C and A. The intensity is increased above C at the expense of the region below. The potential is numerically discontinuous at the line CAD, but the gradient is uniform on the sides of the gap so that there is no discontinuity in B.

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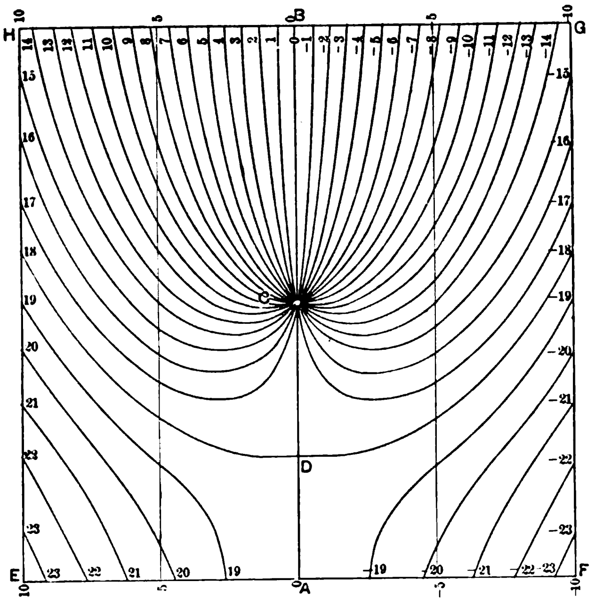
[1] *Copyrighted, 1892, by A. E. Kennelly.*

At the point D, the perpendicular intersection of two equal gradients there is absolute neutrality, and here the fluxes from the two systems, equal and opposite, disappear in union. The distance of this point from the centre of the wire we know to be $\frac{2c}{B}$, or, in this instance, 0.573 cm. Generally, if B represents the prime intensity, and C the vector current, the resultant intensity B^1 at any point whose axis vector is ρ in the plane outside the wire will be defined by the relation

$$B^1 = B - \frac{2}{\rho^2}\, V.\, C\rho.$$



SCALE, ⅜ FULL SIZE.

FIG. 20.

The combined influences of the tension along the lines of flux that bend over the wire, and the side pressure from the more crowded flux above, are to press the wire down from C towards A with the force expressed in dynes by the equation

$$P = V.\, CB;$$

and this relation holds in all cases for a steady, straight current C making any angle with a uniform intensity B. In Fig. 19, B and C are mutually perpendicular, their influence is a maximum, and $P = 1.432 \times 5 = 7.16$ dynes acting along CA, upon every centimetre of the wire's length. In 3 metres of this wire, the total magnetic pull would amount to 2,148 dynes or 2.19 grammes weight.

The simple equation last stated is practically important. It shows that when the straight wire is not perpendicular to the flux, but is inclined to this at an angle θ, the pull is reduced to $C\,B \sin\theta$ dynes per cm. The wire may be considered in such a case as having two components, one $\cos\theta$ along the direction of flux, and uninfluenced by stress; the other $\sin\theta$ across the flux perpendicularly. From this point of view, the whole pull is exerted upon the virtual component of the wire's length at right angles to the flux. Again, if the wire is not straight, or the flux not uniform, it becomes necessary to subdivide the length into such a number of smaller sections that the wire may be considered straight and the field uniform in these narrowed limits without sensible error. The pull must then be found for each section separately, and the resultant of all the actions determined. In some cases it will be possible to avoid this tedious process by finding an average by inspection; in others the rules of the integral calculus will be applicable. But however complex the arrangement in the number of wires or the difference of strengths of current they carry, the fundamental principle is the same,—the pull on each element $d\,l$ of conductor carrying a current c in an intensity B making an angle θ with its direction, will be $d\,l\,.\,c\,.\,B \sin\theta$ dynes directed perpendicularly to the local plane of B and C; and each element acts independently of all the rest. The direction of motion is perhaps best remembered by Fleming's rule, often useful in dealing with motors. If the *f*irst *f*inger of the left hand points in the direction of *f*lux (that is by following the north-seeking end of a compass needle), and the bent middle finger, the current,—the outstretched thu*m*b perpendicular to these will point out the direction of *m*otion.

We have hitherto assumed that the prime flux was not altered by, but merely compounded with, the flux due to the currents in the wire or wires. If, however, the flux of the currents alters the prime distribution, as might take place in the vicinity of iron by the establishment of induced M. M. F.'s, these alterations would have to be accounted for and effected in B, if they are of sufficient importance to affect the result, in order to arrive at the true moving forces.

Fig. 20 gives the resultant potential system for a straight wire with $C = 2.864$, and uniform prime intensity $B = 2.5$. P has the same value as in the preceding case of Fig. 19, the prime flux being halved, and the current doubled. It is to be observed that notwithstanding the equality of forces in the two instances, the distributions of potential and therefore of flux differ materially.

NOTE ON THE NATURE OF ELECTRIC CURRENTS.

BY

William James Morton, M.D.

It has long been noted that when a piece of cardboard is pierced by the disruptive discharge or spark, a burr or protuberance is produced upon *each* of its faces. No satisfactory explanation, so far as I am aware, has been offered of this phenomenon, but the experiment is often cited as furnishing an inference that something has acted upon the cardboard in opposite directions at the same instant. The experiment does not prove that the forces acting pass by each other. Mascart, in giving expression to the commonly accepted view, says:

"The paper appears to have become electrified by induction, and each of its two surfaces seems to have been attracted by the nearest point of the two metallic conductors."

And Sprague says: "If a discharge be passed through a card by pasting upon its two sides pointed pieces of tinfoil with their points not quite opposite, there will be a burr produced upon both sides, indicating that the force is not a penetrating one but a pulling one, acting by attraction from each pole." A simple experiment, which I here outoutline, throws, it would seem to me, a new light upon the nature of the disruptive discharge, and possibly upon the nature of electric currents in general.

If, in place of a single piece of cardboard, a pad consisting of numerous sheets, say fifty or more, be caused to be perforated by the spark of an influence machine, to each of whose prime conductors is attached a Leyden jar whose outer tinfoil coatings are electrically connected, a new set of appearances from any described may be found upon careful examination of each sheet. The disruptive spark discharge has, in its progress, left a record of certain peculiarities of its passage, like the imprints found of fossils. The two outside sheets will exhibit the characteristic burr or protuberance, of a conical shape, but as successive sheets are lifted (the entire pad is united like a book at one end) it will be observed that each exhibits a hole, one-half of whose rim is an indentation and the other half a lip or projection. The appearance is as if two needles had been thrust by each other in making the same opening, each one thrusting the paper before it in opposite directions; or again as if two express trains had been rushing by each other throughout the length of the same tunnel, scraping along fragments of plastic walls, one in one direction the other in an opposite direction. The two trains must be supposed to be practically frictionless as regards each other, but accompanied by friction as regards the tunnel.

The deduction may be indulged in that the spark discharge consists in like manner of two elements corresponding to the two polarities, which travel in opposite directions and in relation to each other.

But further examination discloses that the two opposite moving forces have not traveled in the same plane, as is the case with the trains, but that, being free in space and untrammeled by gravity and a fixed track, they have spiraled around each other for a certain distance, then abruptly and mutually changed the direction of their spiral turns to an opposite direction, and repeating their sudden changes several times in the distance of an inch. This fact is demonstrated by lifting the perforated sheets of the pad one by one and observing that the projection (or the indentation) upon their face is found to progressively change its point of compass. Starting, for instance, at the left or west end of the paper, Fig. 1, the burr will be found, as each sheet is lifted, to be more and more to the east, or may extend even to beyond the south; its direction then suddenly changes, passes back again by way of the south, even to the west, and so on, presenting several such alternations in a distance of half an inch.

Fig. 2 indicates the usual appearance of a single sheet of paper perforated by a spark. Fig. 3 represents in a schematic manner that upon any of the inside sheets of a large number, closely approximated as in a writing pad; each face exhibits both a projection and an indentation.

I may here also mention another simple experiment pointing to a rotary action of the current. If a piece of moistened fine cotton thread, say about 4 inches in length, be tied to the ends of each discharging rod, the thread will, upon approximating the rods (the influence machine being in motion), twine about each other several times. If the threads are dry this action will not take place, nor will it if they are too wet; when dry, they fly together and apart without twisting, when wet, upon the first contact they adhere and convey all the current without further movement.

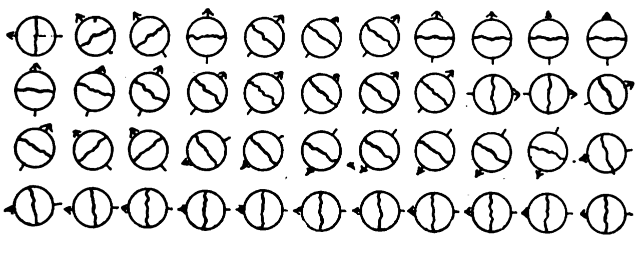


Fig. 1.

The experiments suggest:

1. That the electric disruptive discharge or spark consists of two parts traveling in opposite directions, together constituting a current.

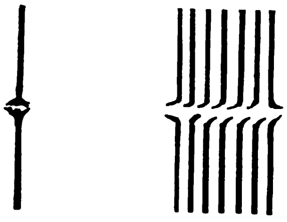
2. That these two parts move in opposite spirals around each other.

3. That, in the spark form, the direction of the spirals is frequently and mutually alternated.

5. That the angular, broken, or zigzag appearance of lightning and of large and long sparks represents the point at which the alternations in direction of the double spirals occur.

5. That if in the air-gap part of an electric circuit a "current" consists of two parts oppositely spiraling around each other the same may be true of the current in the metallic or "conducting" part of the circuit.

6. That two spirals moving in opposite directions and upon each other must be subject to friction and thus occupy time in their progress as well as present other phenomena of friction.



Figs. 2 and 3.—Paper Perforated by Sparks.

But whatever deductions may be indulged in, the experiment itself would seem to be new and, as pointed out, possibly suggestive.

THE CITY AND SOUTH LONDON ELECTRIC RAILWAY.

BY

Edward Hopkinson

In the present session of Parliament no fewer than six bills have been introduced authorizing the construction of new underground railways in London to be worked electrically or the extension of those for which acts of Parliament have already been obtained. Three of these bills have passed through the House of Commons and are in an advanced stage in the upper house. The present time, therefore, is opportune for drawing attention to the results which have been attained with electric traction on the only railway in the world on which it has been adopted on an extensive scale; and the working of which during the eighteen months it has been open for public traffic is the basis upon which the promoters of the present schemes found their application for parliamentary powers; and from which they must in the future seek the confidence of the public.

That the City and South London line has been a success in the system of traction adopted is conclusively shown by the mere fact of the present schemes being brought forward, and has moreover been abundantly proven by the evidence given before the joint committe of both houses, appointed to consider the proposed lines from the general point of view of their public utility and also by the evidence given as the bills passed through committee in the lower house; but it has been pointed out that no authentic information has been forthcoming as to the actual results achieved nor any explanation of any shortcomings in its working, which must be obviated in the future.

The limits of this communication do not permit the discussion of the engineering features of the electrical plant adopted, but as my firm designed and constructed the whole of the electrical equipment of the railway, the present occasion is not inopportune either in time or place for me to give a brief account of the history of the first year's working and of the results achieved, leaving for some other occasion a discussion of the technical details.[1]

The City and South London Railway Company, then known as the City of London and Southwark Subway Company obtained its first Parliamentary powers in 1884 for the construction of a subway from King William street, in the City to the Elephant and Castle in Southwark. The success, however, of Mr. Greathead's beautiful system of constructing the tunnels, now familar to all interested in engineering matters, had been so conspicuous that the directors obtained powers in 1887 for an extension to the Swan Inn at Stockwell. Further powers have since been obtained for an extension southwards to Clapham, but this portion of the line has not yet been constructed. It was originally intended that the Subway should be worked on the cable system and contracts were actually entered into for this purpose, but the progress of electrical traction in the interval, made it necessary to reconsider the system of traction to be adopted. The Bessbrook and Newry tramway (more correctly described as a railway) had been equipped with electrical plant by Messrs. Mather and Platt and had been running with perfect regularity for three years. The weight of the trains on this line was but little less than the weight of the trains proposed for the South London line, but the cost of haulage had been proved not to exceed 4d. per train mile, although the mileage was small and consequently fixed expenses high in proportion.

The success attending the Bessbrook line induced Messrs. Mather and Platt in 1888 to approach the directors of the City and South London line and to make definite proposals to them for working their line electrically, instead of by cable. After long consideration the cable system was finally abandoned and Messrs. Mather and Platt's scheme accepted in its entirety. Their proposal was accompanied by an offer to work the line for a limited period or to guarantee the cost of traction for two years. The locomotives were to be designed for drawing trains consisting of three carriages accommodating 100 passengers, and weighing 4¼ tons each, and the generating plant was to be sufficient for working a service of 20 trains per hour. A contract was entered into with Messrs. Mather and Platt in January, 1889, and their guarantee accepted, that the cost of haulage exclusive of drivers' wages should not exceed 3½d. per train mile for the maximum service proposed, viz., 384,800 train miles in the half year, and according to a sliding scale, if the mileage were more or less, increasing up to 7½d. per train mile for 188,666 miles, the actual mileage accomplished. The works were completed in November, 1890, and on the 4th of November were formally inaugurated by the Prince of Wales accompanied by the late Duke of Clarence.

On December 18, 1890, the line was opened by public traffic; and has now completed eighteen months' running. During this time Messrs. Mather and Platt's locomotives have run more than 500,000 miles and have provided for a traffic of more than 7,000,000 people; but this statement alone does not fully represent the work which has been demanded from them. Owing to the carriages being made stronger and heavier than originally designed, the actual load of each carriage being 7 tons instead of 4¼ tons, the weight of the loaded train was increased to 42 tons, or more than 40 per cent. heavier than the trains for which the locomotives were designed. Of this great increase in the loads which their locomotives were to draw, Messrs. Mather and Platt had no intimation until after all the locomotives were constructed and delivered, and arrangements had been made for the opening of the line. Under such unexpected circumstances the locomotives have at times been overstrained, and delays to the traffic resulted, and the wear and tear has proved somewhat greater than originally anticipated, yet the record of work done by the electrical locomotives in comparison with the work done by steam locomotives is extraordinary. Leaving out of consideration one of the locomotives of special type made for the purpose of testing its comparative efficiency, the average mileage made by the remaining 13 locomotives during the first year of work exceeded 27,000 miles. On the Metropolitan district railway the yearly average of their locomotives appears to be less than 20,000 miles.

The cost of working has proved equally satisfactory. Although the formal guarantee of Messrs. Mather and Platt was not taken up on account of the carriages failing to comply with the specification upon which they were requested to base their calculations, yet their estimate of cost has been amply justified. During the second six months of working, according to the published half-yearly accounts, the cost of locomotives and generating power, including wages, repairs and renewals, was £6,199, for a mileage of 188,666, or less than 8d. per mile. If allowance be made for the drivers' wages, which were excluded from the original estimate, this is equivalent to about 5½d. per train mile, 25 per cent. less than the amount guaranteed by Messrs. Mather and Platt, although the weight of the trains had been increased 40 per cent. These facts are the more striking when the difficulties of adequate and regular inspection of the rolling stock of a line entirely underground are considered; difficulties which do not obtain in the case of any ordinary railway, and when it is further remembered that the entire system of working was novel, to which the employees of the company were unaccustomed, and for which they had received no special training. Under the able management of Mr. Basil Mott, the company's engineer and Mr. T. C. Jenkin, the general manager, it is probable that the working expenses will be still further reduced, while the mileage and traffic receipts are being steadily increased.

The distinguishing feature of Messrs. Mather and Platt's locomotives is that the armature is constructed directly upon the axle, and the magnets supported partly upon the axle and partly upon the frame. Probably this design, obviating all gear and reducing the mechanism to the simplest elements, has contributed more than anything else to the successful working. For the heavier trains which will be required for the working of the new lines there will be no difficulty in designing heavier and more powerful locomotives on the same principle. In the schemes now under consideration Mr. Greathead is proposing larger tunnels 12 feet in diameter, instead of 10 feet, as in the case of the City and South London line. This will greatly facilitate the construction of larger locomotives and more commodious and comfortable carriages, which are the chief points necessary to ensure the success of the new undertakings.

AN EIGHT-FOOT SPARK.

At the recent Royal Society conversazione Mr. James Wimshurst, says *Engineering*, gave another proof of his fertility of invention by an entirely new demonstration. He had a number of metallized surfaces 9 feet long, covered with copper, tin, brass and other metals. At each end of such a surface he placed a Leyden jar; some of the jars were coated with tin and others with brass. When the jars were charged from one of his large machines they threw out sparks over the coated surface, the color depending on the metal employed. With brass they were a vivid green, with tin a dazzling white. At first the sparks appeared at the edges of the jar, and as they gathered strength, radiated beyond them. Gradually they became like adders' tongues darting in all directions, and beating themselves on the metal surface in a futile attempt to get away to earth. At length the tension rose until the electricity found itself able to fling itself over the entire distance from jar to jar, and the magnificent spectacle of an 8-foot spark was seen.

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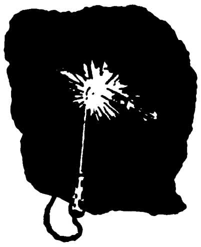
[1] A complete, illustrated description was given of the road and plant in THE ELECTRICAL ENGINEER. Vol. X, No. 134, Nov. 26, 1890, p. 585.

MODERN STAGE LIGHTING.—"SINBAD" AT THE MADISON SQUARE GARDEN.



"*Lightning.*"

THE importance of good lighting upon the stage is only second to that of a good cast, and a very clever piece, well set, well costumed and well acted may be marred at its first presentation by inadequate lighting effects. The average theatre goer, in fact, has no idea of the amount of light used, nor how ingeniously it must be thrown exactly on the right spot at the right moment to produce the proper effect. There must be no sudden glare when dawn breaks; no jerky gradations of twilight when the sun sinks behind the hills; the whole system must be so perfectly under the control of the person in charge that it will instantly respond to the requirements of the piece, as circumstances demand, and leave the spectators with a pleased sense of completeness in the whole. To be perfect it must be as unobtrusive as the daylight, and suggest its mechanism as little.

It seems singular, in view of these facts, that the electric light has not been used more extensively in the theatres of this country, at least where managers are certainly unsurpassed in enterprise in other directions. Incandescent lamps in footlights and borders are, of course, almost universal, but there has been no serious effort made until very recently to supplant the clumsy, noisy and expensive calcium by an electric arc lamp, though the latter is easier to control, much cheaper to operate, takes less space and is practically noiseless.

The first spectacular production in this city where such a system has been wholly and successfully adopted is the extravaganza "Sinbad," now running at the Garden Theatre under the management of Mr. Wemyss Henderson, of Chicago. The lamps used are the invention of Messrs. W. O. Meissner and Martin Krueger, and are under the direction of Mr. P. Armstrong, who, by the way, is so deeply impressed with their usefulness that he has disposed of his interest in the Chicago Calcium Light Co. and thrown his influence on the side of electricity *vs.* lime. There are fourteen in use, each of 4,000 c. p. but toned down considerably by refracting shades of ground glass. They are run on the regular incandescent street circuit from the Edison mains, and hence the current can be taken from the regular bunch light pockets, no extra wiring being necessary.

A comparison of the relative merits of the arc light as compared with the calcium is of especial interest. Each of the latter requires a man to operate it, while the whole set of arcs may be controlled by one man at the switchboard; the calciums are practically stationary, while the arcs are perfectly portable; and last, but none the less important to the management, the cost of one calcium is from $1 to $1.50 per night while that of one arc is from 19 to 20 cents. These lamps, by the way, are used successfully in St. Louis for racing at night, and it is intended to use about 100 of them on floats at the dedication of the World's Fair.

In addition to the lamps on the stage, there are two similar ones in the color box in the centre of the gallery, and close beside them, so that all may be readily operated by one man stands the "vision light," a lamp of the same character, but provided with an adjustable lens and a reflector, and capable of being turned about in all directions. The switches for these three lamps are fixed upon the gallery rail at such a height from the floor that the operator can throw them with his knee while his right hand is occupied with the color box and his left with the lens.

These gallery lamps play an important part during the shipwreck scene in the second act. The twilight is made by four stage lamps and the reflector; for the moonlight that follows, one stage light is used, covered with a green gelatine shade, the border lights being turned low; then comes darkness, followed by the storm, and as this clears and the ship is seen sinking, the green shaded stage lights are supplemented by both of the color-box lights, while the reflector is concentrated upon Sinbad slowly rising from the bottom of the sea.

The lightning during the storm is particularly well done, and the apparatus for producing it is absolutely unique. It consists of one old file, one equally old piece of brass rod and one dead short-circuit. Real lightning is the result, and the effect is perfect.

The remainder of the play offers no other opportunity for such a striking piece of work, but notwithstanding, one cannot but be impressed with the evenness of it all. It is to the credit of Mr. Henderson and his assistants that they have been the first to give to electric stage lighting an impetus which is bound to bring it into favor at no distant day with other managers who wish to keep abreast of the times.

SOME NOTES ON THE EXECUTIVE MANAGEMENT OF STREET RAILROADS.

BY

A. K. McCay.

THE importance of this branch of railroad operation will not be gainsaid by any one. Executive ability is born, not bred, and as a manager has this quality so also is his worth. By the executive branch of the management may be understood the whole management of employees, from the officer directly under the manager, to the day laborer on the track; also the management and direction of all supplies bought, promotion of travel, accidents, and the dealings with the municipal government.

The writer will assume that an entirely new road is being built ready for the executive officer to take charge and will briefly refer to the departments and to the problems to which a manager should particularly apply himself. But before going into details the writer wishes to impress upon owners and directors of street railways the absolute necessity of allowing the manager *full* and *free* control; he should be the absolute and not the nominal head, directing and guiding its policy in every branch. It has been demonstrated too often that a board of directors *cannot* sucessfully operate a street railway. Choose your man, in whom implicit confidence can be placed and who has the best and permanent interests of the road at heart, whose zeal and experience are known; then allow him to exercise unhampered and unfettered control.

When these powers have been conferred, the manager will begin by appointing his assistants, namely, the electrician and superintendent; these two offices can be combined in small roads. The conductors, motormen, car cleaners, and inspectors will be under the superintendent, and should be engaged by him. The engineers, firemen, oilers and linemen will be under the electrician and he should be allowed to engage them. This matter of allowing the superintendent and electrician to engage their own men is a great help to them in maintaining the discipline of the road. The men will work better, have more respect, and be more strictly obedient to the man who engages them than to one they recognize as subordinate to the manager. The moment they see that the manager reposes confidence in the electrician or superintendent, the same moment will they accord him additional respect and prompter obedience.

A time-table should be prepared and submitted to the manager, together with a code of rules, and conductor, engineer and car inspector reports. Every day these various reports should be handed to the superintendent and electrician, so that each morning they can in person report to the manager, noting in detail anything which may have occurred the previous day.

Having then thoroughly organized his force, through his two lieutenants, and having gone through and sifted the rules and reports and satisfied himself as to their usefulness and practicability, the manager can turn to the purchasing of supplies. These should all be bought from the manager's office; the superintendent and electrician inspecting whatever comes to their respective departments, recommending or disapproving, together with reasons, in writing, their supplies. In this manner the best of coal, oil, grease, etc., as suited to the exigencies of the occasion, will be secured.

The question of travel will next engage the manager. It is assumed that the road is situated in some city of moderate size where the cars are not overcrowded and that travel must be more or less created, or at least encouraged. Having made the schedule, and having operated the same for a short while, the conductor reports should be examined. From these can be readily obtained the hours of the day when travel is the heaviest. Extra cars should be run during these hours, and during the lightest hours cars may be taken off.

Of course on some days of the week travel will be lighter than on others. These should be noted and if possible special attractions should be offered to promote travel. During the summer months this can be very easily done by concerts held in some park or hall at the end of the line. The manager should exercise every ingenuity to furnish attractions of one sort or another which can be obtained without *too much cost,* which shall attract crowds. The writer knew a case in which a manager spent some five dollars on a set of negro camp-meetings, feeding the colored people till they became self-supporting, which was in a day or so, and receiving back some three hundred dollars in car fares during the time the meetings were held. A manager must be quick to grasp the opportunity of carrying the crowds on such occasions, giving full and ample accommodations for riding, as nothing will detract from amusements so much as a poor return service. If he has insufficient car capacity, try to move them in sections, prolonging the entertainment to hold part of the crowd while a portion is being moved.

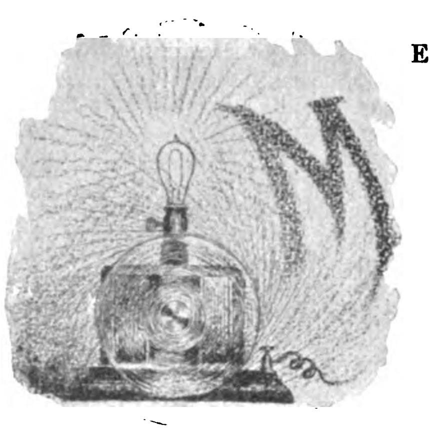
In winter the same plan should be pursued; a skating carnival, a dance, or a concert in some hall towards the end of the route will prove attractive and increase receipts. Too much attention cannot be paid to this branch, with liberal assistance to any enterprising individual who wishes to open a pleasure ground at the end of the route.

Accidents will happen on the best regulated roads; and only one piece of advice is necessary, that is, to compromise. The writer knew of a road which was unfortunate enough to run over a capitalist and kill him. The widow had ample means to fight the company; but by excellent management of the case, it was compromised at *two hundred* dollars!! The road should endeavor to pay such claims by tickets, or privileges granted; actual cash being the last and final resort. Delay is a very potent factor in the settlement of such cases, and the collection of evidence *at the time* may be *invaluable.* The rules should state, that in case of an accident, the conductor and motorman should get the names and addresses of *all eye-witnesses* and make a written statement of the affair to the superintendent, who in turn will report to the manager.

Every manager will be called on to cope with the city fathers, either in getting a new franchise, a side track, or placing a pole. A general piece of advice which may prove useful is to meet and conquer them individually before being called before them collectively. Count noses, only be sure they are counted correctly. A manager who requests a grant from the council and who does not consult them individually before presenting the same, is not wise, and will oftener be denied than granted the privilege.

An executive officer who is thus equipped, with a pair of good lieutenants, the best men obtainable as employees, a ready and facile ingenuity for promotion of travel, and a mild form of diplomatic ability in dealing with the aldermen, cannot fail to render a good report both for himself and for his road.

THE DAY OF THE FAN MOTOR.



MERCY is certainly not strained in quality this weather when it takes the form of a cooling breeze from a fan motor, for it would be hard to imagine anything more grateful and refreshing. The appreciation of the benefits of a steady flow of air has become very keen, and it seems likely that the public will in due time expect fan motors and free breezes as a matter of course, just as it now does ice water. In fact there can be no question that the use of electric fans invites business, and we know of one large New York restaurant down town that suffers loss of patronage because it is without them. One of the customers remonstrated with the proprietor the other day, and was told that the reason was that he had had trouble with the electric light 10 years ago. Thus do the sins of the pioneers come back on those who have a good thing to sell!

Be that as it may, the reports as to a good "fan motor" season are very general. In many parts of the South, it has ceased to be a "season" trade, and a man now on taking a store thinks of his fan motors as among the first fixtures to be secured. The number of fan motors sold in the South this year is very large, and throughout the country the demand has been excellent. It would have been even larger, were there more circuits to put the motors on. For alternating fan motors the inquiry has been peculiarly brisk, while 500-volt motors especially for railway circuits, which it is already the custom to tap, have become a standard article.

Now that the fan motor has won its place, and bids fair soon to be as numerous as the sewing machine, some makers are seeking to win attention by novelty. In this line, the pivoting fan which travels around its base distributing a breeze in every direction with the strictest impartiality, has made a decided hit, and we may look for changes to be rung on the idea. A popular novelty is the little motor in the shape of a ball or globe; and this is ingeniously hung sometimes from the ceiling by chains, so that it can be swung in any direction or can send its breeze down or up at any angle.

Not only are the makers aiming at novelty, but the users are striking out after novel advertising effects with fan motors. It is confidently expected that before long, hotel proprietors will make a special card of having a fan motor in every bedroom. But it has also been found that very funny effects can be created with the breeze. Hence the pretty device is often seen of red, white and blue streamers flapping and fluttering like pennants in a gale, the current of air that keeps them up coming from the adjacent fan. Just to watch them gives a feeling of coolness. A startling variation on this idea has lately been tried by an enterprising storekeeper, who filled up his window with a lot of white feathers and then set an electric fan running near by. The appearance of the window was fantastic in the extreme, and two policemen were required to keep moving the crowd of those who wanted to see the "feather-dance."

A very amusing scheme to pique public curiosity in this way has been hit upon by J. H. Bunnell & Co. at their electrical supply store on Cortlandt street, this city. In the window are displayed a number of fan motors of various sizes. It is clear to all that they are without electrical connection, yet some are moving in one direction, and some in another, and all at different speeds. An inquisitive crowd may be seen around the window at all times, wondering and expressing admiration like so many exclamation points. Others in the throng discuss the question : "What makes them go?" Among those who stopped to see the sight recently was the editor of an electrical journal, who explained loftily—as editors often will in such cases when their superior wisdom is appealed to—that there was a concealed connection somewhere. He felt taken aback, on going inside to prove his theory, to find that the motors had no connection at all with any circuit. The explanation of the mystery is simple. At one side of the window is an alternating current motor whose fan revolves so quickly that it is not easily noticed. The other fans are stationed opposite to it, and in places of the best advantage to catch the breeze. They revolve according to the pitch of their fan blades, and each makes obeisance to the master fan like the historic sheaves of wheat around the central one. The trick is clever, and deserves all the success it meets with in drawing the gaze of the public that way.

EXHAUSTING INCANDESCENT LAMPS BY MEANS OF MERCURY PUMPS.

BY

J W Packard

I do not wish to enter into a discussion regarding the relative merits of mechanical versus mercury pumps as used in exhausting incandescent lamp bulbs, but simply to correct a generally accepted opinion that the cost of lamp making will be materially reduced by the adoption of the mechanical pump. The following are the actual figures of the cost per lamp in the pumping department of a medium sized factory, exhausting about 2,000 lamps per day:

Labor, pumpers	$0.00727
" glass blowers	.00583
Repairs and supt	.00191
Material	.00077
	$0.01578

This gives a total of a trifle over one and one half cent per lamp.

These figures are from actual practice, and will of course vary slightly, but are neither above nor below the average, and represent the total cost of pumping for finished lamps. In some larger factories I have no doubt that the cost is materially less than this, while in others it probably runs up as high as three to four cents per lamp. There is a mistaken impression that mercury pumps as at present used require a great deal of attention. In the case of the factory mentioned above and in any well-equipped modern lamp factory, using the so-called Geissler pump, the pumps are absolutely automatic, the mercurial pistons rising and falling with clock-like regularity during the entire time that the factory is in operation, the labor of the pumpers consisting solely in placing the lamps on the pumps, in turning on and regulating the current and in removing the lamps at the proper time. It is manifest that this labor cannot be reduced by the employment of the mechanical pump, however perfect and rapid its action. The labor of the glass blowers, too, in attaching the lamps to the pump connections and in sealing off the tubes through which they are exhausted must be the same, whatever kind of pump is used. It is difficult to see how the items above mentioned, of repairs and superintendence and of materials which consist of acid, oil waste, etc., can be much reduced.

In the above-mentioned system of pumping, which is in almost universal use in this country, it is of course understood that the atmospheric pressure is never admitted to the operating bulb of the pump and that the preliminary exhausting of the lamp before connection with the mercury pump is established, is done by means of a mechanical pump, this operation consisting in the mere opening and closing of a stop-cock. The mechanical pump used for this purpose is almost without exception the Packard pump, which is a modified form of the Ritchie and gives in regular use a vacuum approaching to within ½ inch of the barometric pressure. The size of the mercurial pumps used is limited not so much by the difficulty of constructing and operating them, as by the undesirability of attempting to exhaust more than a certain number of lamps on one pump at a time, as a leak or defect in one would destroy the vacuum in all of the lamps on that pump. The pumper's most difficult task is, when a leak is developed on a pump, to discover the defective lamp in order that it may be removed and the exhaustion of the remainder proceeded with. This difficulty would be greatly increased in the case of the mechanical pump, where it is claimed 600 lamps are pumped at one time, and it would be impossible to secure a perfect vacuum until all leaky lamps had been removed.

The time taken for exhausting too, is dependent as much upon the slow and careful electrical treatment to which it is necessary to subject the carbon at this stage, as upon the displacement effected by the pump piston.

From the considerations and figures given above it is manifest that the claims made by the inventors of mechanical vacuum pumps for the complete exhaustion of incandescent lamps, that a saving of 8 cents, or more, per lamp, can be effected by the substitution of mechanical for mercury pumps, are absolutely without foundation since, supposing that the entire operation and cost of pumping were done away with, a saving of but 1½ cent per lamp could be effected.

In one of the mechanical vacuum pumps for this purpose the inventor states that he uses a non-volatile liquid and that a vapor of oil or hydrocarbon is left in the bulb, presumably from this liquid. The claim is made too, that a vapor of mercury is left in lamps exhausted by the old process, which is very injurious to the lamp, causing a rapid blackening. I am unacquainted with any authority for, or any evidence which would tend to sustain, this statement. In the recent test by Prof. Thomas at the Ohio State University, the "Packard" lamps, which are exhausted by the mercurial process, showed considerably less blackening than any of the other makes, among which was the "Beacon" which is exhausted by the mechanical process. The leaving of a vapor of hydrocarbon in a finished lamp has often been tried and at one time was quite extensively practiced at one of the largest lamp factories in the country, but was soon abandoned as being of no utility. The presence of any vapor in a finished lamp imparts a dull appearance to the carbon and makes the bulb distinctly visible, it appearing to be of a slight yellowish tinge. In all the mechanically exhausted lamps which I have examined, this appearance is quite marked.

PROPOSED ELECTRIC TRANSMISSION OF POWER AT TROLLHOTTAN.

The question of erecting an electric installation for the transmission of power from the large Trollhöttan waterfall to Gothenburg, says *Industries*, has so far advanced that about one hundred firms in the latter town are willing to use electric power from Trollhöttan if conveniently installed and subject to prices being suitable. The amount of motive power and electric lighting required by these applicants amount to respectively 5,262 h. p., and 8,395 incandesent and 178 arc lamps. The plan, if realized, is likely to become the forerunner of many similar installations in Scandinavia.

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VOL. XIV. NEW YORK, JULY 20, 1892. No. 220

Every change of condition, every transformation of matter, and every manifestation of life is at the expense of some motive power, which having performed its part, is forever neutralized.—Joseph Henry.

ELECTRIC TRACTION IN GREAT CITIES.

IT is interesting and encouraging to observe how thoroughly the idea of electric traction has found acceptance in great cities. In fact there are few great cities in which it has not been tried, and while the methods are various, the results generally are very satisfactory. The article we publish this week from Dr. Edward Hopkinson tells what has been done on the underground road in London, and shows how bright the prospects are for an extension of the system. So far we have no such road in this country, but there is every promise that New York will soon have one. In the meantime the trolley is making its way, and that method has already given proof of enormous capabilities for passenger transportation, there having been, for example, no fewer than 625 trolley cars running in Boston on the Fourth of July.

At the present moment, storage battery traction again looms up, and both New York and Brooklyn are again discussing the subject. In New York, the proposition is made to operate the Second avenue surface road by batteries, presumably the Waddell-Entz, and if the plan is tried it is to be most devoutly hoped that the experiment will succeed. While the storage battery is steadily gaining ground for lighting and for stationary power work, it still has to demonstrate its commercial utility in traction, especially on roads with grades, subject to frost and snow, and handling such heavy traffic as falls more or less to the lot of all city roads. Our best wishes go with the work now on foot in New York, Cleveland, Washington and elsewhere, but we cannot approve the proposal to employ storage batteries on the Kings County Elevated Road in Brooklyn. Such a road is an ideal place for the trolley system, and all the supposed objections to the trolley on a surface road disappear at once. We can see no advantage in adopting a complex method when a simple one will serve every purpose. Even if it is intended to break up the trains into single car units, the trolley would still seem preferable. But if Genl. Jourdan carries out his ideas, he can count on cordial co-operation for every man in the electrical field.

It is a pity that this co-operation cannot be gained from other men who should be equally interested in the adoption of improved and modern methods of light and power. A conspicuous example of obstruction is found, we are sorry to say, in the person of Mr. David M. Stone, the venerable, but not venerated, editor of the New York *Journal of Commerce*. It is a marvel that the intelligent and informed merchants of this city and Brooklyn can listen tolerantly to the nonsense that he is printing as supposed argument against electricity. Only the other day, attention was called in these columns to his absurd assertion that riding in trolley cars in Brooklyn would cause a large number of cases of palsy. Another effusion of his published in the *Journal of Commerce* last week, holds it to be probable that the present use of electricity is causing the cyclones in the West, and after saying that "as a motive power electricity is winning a most condemnatory record," and alleging that in Boston "several hundred are killed or seriously injured every year by the trolley," winds up as follows with regard to the trolley in Brooklyn: "There never was a more infamous assault upon the peace and safety of a great city than this project carried to a successful issue on the other side of the East River."

After all, this is amusing from a Brooklynite who opposed other benefits his fellow-citizens now enjoy, including gas, ferries and the elevated road. It is, perhaps, no more than could be expected from one who has been prominently interested in a perpetual-motion machine, and who, if report be true, severed his connection with a Brooklyn club because it introduced the electric light. But it is not so amusing when we remember that these wild sayings about electricity appear in a newspaper which has long commanded the respect of the merchant princes of America and still has their ear. Patience is, perhaps, the only remedy. The men who opposed steam railroads have now all disappeared, except in China, and by and by electricity will also be free from the attacks of ignorance and prejudice.

THE PHYSIOLOGICAL EFFECTS OF HIGH FREQUENCY ALTERNATING CURRENTS.

THE harmless nature of alternating currents of high frequency at enormous potential cannot be explained away on the theory of the small quantity involved in their passage through or along the human body, for some of the experiments performed by Mr. Tesla with the current transferred through his body involved electrical energy sufficient to have given positive discomfort, to say the least, if administered in any other way. Prof. Edwin J. Houston, whose ideas on electro-physiological questions are always interesting, in a short paper recently read before the electrical section of the Franklin Institute, suggested that an explanation of the observed phenomena can be found in adopting the modern hypothesis that the electric energy is not propagated through the mass of the conductor itself, but rather through the dielectric or medium lying outside the conductor; that, as it were, the electric energy is rained down on the surface of the conductor from the space outside it, and soaks down into the mass of the conductor, the conductor forming a sink or place where the energy can be dissipated. According to Prof. Houston's conception, in the case of a steady, continuous current, the energy sinks or soaks rapidly through the mass of the conductor, so that the electric current, in the language of the old ideas, passes through all portions of the mass of the conductor.

In the case of alternating currents, however, the energy received from a single impulse or electrical movement, by sinking or soaking moves, say, from the surface of the conductor towards the centre, only while such impulse continues; and, when the direction of the impulse changes, moves in the opposite direction, or towards the surface.

When the human body is subjected to the effects of discharges of alternating currents of enormously high frequencies, the superficial portions only are traversed by the discharges. The more deeply seated, vital organs, being thus free from current, such discharges are necessarily harmless. As the frequency of alternation increases, the body becomes more and more protected, until, when the frequency becomes as great as that of the ether waves, which cause sunlight, they would probably produce on the surface of the body the same genial effects as are produced by the light and heat of the sun, with which they are probably identical.

If these views are correct, it would appear that when the human body is exposed to rapidly-alternating discharges, it is subjected at one moment to a discharge that might produce instant death, were it not for the fact that the bolt is practically no sooner hurled at the body than it is hurled away from it.

THE NATURE OF ELECTRIC CURRENT.

That the ordinarily accepted directional nature of the electric current is a convention adopted merely for the purpose of facilitating the fixing of our ideas, is now so generally understood that all electricians are quite prepared to give respectful attention to theories respecting the progressional nature of electric currents, however they may differ from the conventional. Whether that which we call electric current passes from the positive to a negative pole, or whether there be a mutual interchange between the positive and negative poles, and questions of a like nature, have given rise to much discussion in the past, and the recent addition of the ether has served to introduce another element of strife. But as the facts regarding the nature of the electric current are still confined to a small number of experimental demonstrations, any addition to them must be welcomed as a possible aid to clearing up our ideas on this subject. As such the experiments described by Dr. William James Morton, in a note in this issue, will prove of more than ordinary interest; and as the experiments are easy of repetition they may afford a basis for further work in this direction by others. The experiments of Dr. Morton, it must be borne in mind, are in the nature of alternating currents of enormously high potential, and suggest a possible explanation of some of the phenomena in conductors carrying alternating currents, which have heretofore been explained on a different theory. Dr. Morton also suggests a number of hypotheses, based on his experiments.

TRANSFORMER TESTS.

Although reliable tests of transformers have been published from time to time, the corroboration afforded by the testimony of independent testers of repute is always of value As such we note the recent work of Dr. John Hopkinson, who has just finished an elaborate test of two 6,500-watt Westinghouse transformers. Without entering into the details, we cannot but draw attention to the exceedingly high efficiency obtained which at full load amounted to 96.9 per cent., at half load 96 per cent. and at quarter load 84.7 per cent. The magnetizing current of the transformer amounts to 114 watts, or 1.75 per cent., while the drop of potential from no load to full load is between 2 and 2.2 per cent. The increased efficiency at light load brought out these tests, and more partciularly the diminished drop in potential from no load to full load, show marked improvements in the design of transformers over those produced but a few years ago, and must go far towards establishing the value of the transformer, even as a light load converter of energy.

Cyrus Field.

There can be no question that Mr. Field's death was hastened by the troubles and disasters that have fallen upon him heavily during the last year or two; but so far as his life's work went, that may be said to have ended with his grand achievement in uniting the Old World and the New by submarine cable. All that he has done since that time has gone for little, and in fact it may be said to have deprived him of the fortune that his earlier efforts won. His fame and memory will rest upon the noble work of his earlier years. Such men as he are benefactors of the race, even when their aims are most deeply affected by the commercial spirit. Electricity still has need for many such as he.

Regulating Incandescent Lamps.

One of the reproaches brought against the incandescent lamp by the gas companies in the early days was that no convenient means existed for varying its brightness, and that hence the lamp could never be employed economically or to its fullest advantage in domestic illumination. The rapid introduction of electric lighting proved its immense superiority over gas, but it must be admitted that, so far as the early reproach above mentioned is concerned, there was, until quite recently, much truth in it. The Ries regulating socket, for alternating circuits, which has met with deserved success, has apparently stimulated the direct current workers, with the result that we are able to present in this week's issue no fewer than three different devices for varying the brilliancy of incandescent lamps.

A GRAPHIC REPRESENTATION OF THE MAGNETIC FIELD.[1]

BY PROF. EDWIN J. HOUSTON.

BEING engaged in a study of the magnetic field and desiring to obtain some simple method of fixing and readily reproducing the peculiarities of different fields, I have, after numerous trials, succeeded in devising a modification of an old and well-known plan, so simple and efficient, that I have thought it may be of sufficient interest to others engaged in similar investigations, to describe it in detail. The method consists essentially in forming a magnetic field with iron filings on a plate of glass in the usual manner, and subsequently fixing the filings so as to permit the plate to be used as a positive for obtaining a blue print, a silver print, a platinotype, or any other photographic print.

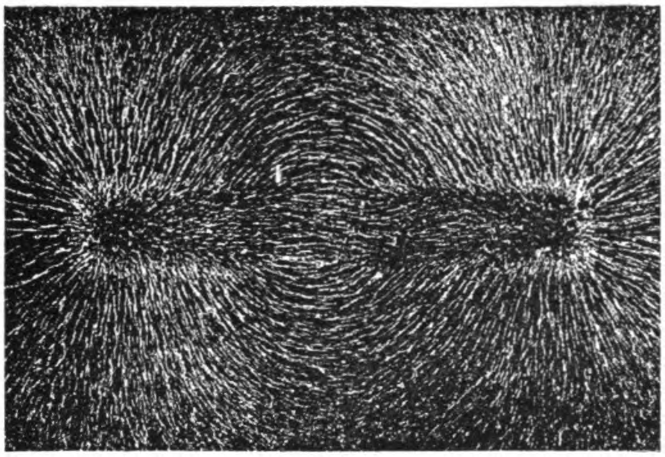

FIG. 1.—FIELD OF BAR MAGNETS.

In order to readily fix the groupings of filings on the glass plate while in the field of the magnet, a thin film of wax is spread over one surface of the plate by any suitable process. A convenient method of waxing the surface of the plate consists in first gradually heating the plate until its temperature is above that of the melting point of wax, and spreading melted wax over its surface by means of a brush. The surplus wax is then allowed to drain off the plate, or it may be wiped off by a piece of warmed paper. The remaining wax is then spread in an even film over the surface by cautiously heating the plate by a Bunsen flame or other suitable source of heat; or, the same thing can be effected by placing the plate in a vertical position in an oven or sand bath, supported on a suitable vessel so as to catch the surplus wax which drains off.

Plates can be readily covered in this manner with an uniformly thin coating of wax sufficiently transparent to permit them to be successfully employed for photographic printing. For such purposes, of course, only pure, white wax is employed.

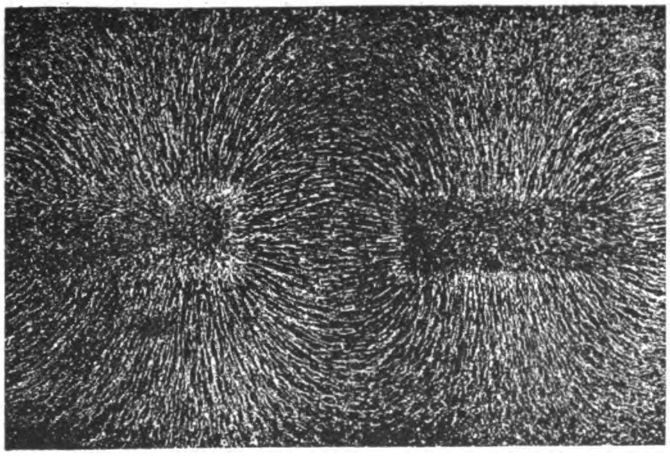

FIG. 2.—OPPOSITE POLES OF BAR MAGNETS.

The wax-covered glass plate so prepared is placed with its waxed surface upward, in a horizontal position over the magnet whose field is to be fixed; and iron filings are sprinkled over its surface. The arrangement of the filings in the characteristic groupings of the field is aided by gently tapping the plate in the usual manner.

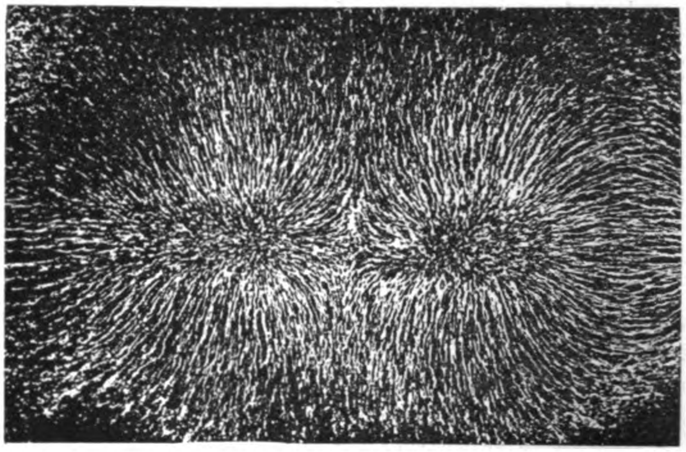

FIG. 3.—SIMILAR POLES OF BAR MAGNETS.

When a satisfactory grouping of filings has been obtained, the field is fixed on the plate by gently warming it so as to melt the wax. At first I adopted the plan of carefully lifting the plate from the magnet and melting the wax by holding it over a source of heat, such as a Bunsen burner; but, no matter how carefully the plate was lifted from the magnet, or how nearly it was raised vertically from the same, so as to avoid lateral displacement of the filings, a change of figure almost invariably attended its removal. Better results were obtained when the wax was melted while the plate was in place over the magnet. This can be readily effected either by holding a heated plate over the warm surface, or more conveniently by cautiously heating it by a Bunsen flame. After a slight heating, the flame may be permitted to play directly on the surface of the filings without displacing them. After cooling, the plate with its fixed groupings of iron filings may be used as a positive for photographic printing. For this purpose it is placed in a printing frame with its surface of wax-fastened groupings of filings upwards, so as to come into contact with the surface of the sensitized paper.

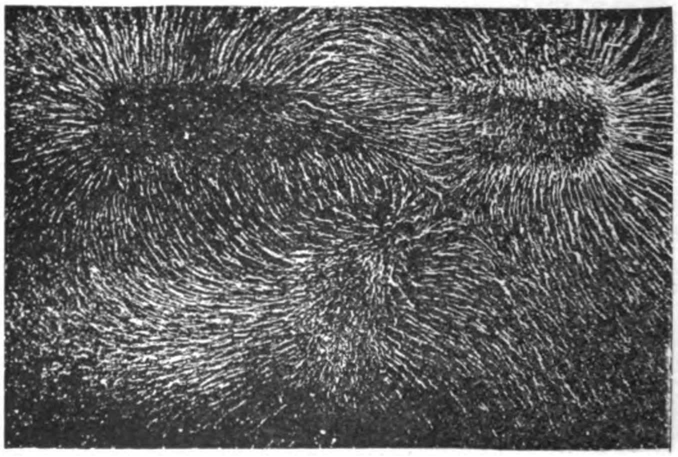

FIG. 4.—BAR MAGNETS AT RIGHT ANGLES TO EACH OTHER.

If the plate has been properly prepared, but comparatively few filings will become detached from the waxed surface when it is brought into contact with the sensitized paper. These should be blown off before taking a second print from the plate. In order to obtain the minimum of roughness of surface, it is necessary to use filings that are as nearly as possible of a uniform size. This can be readily ensured by previously sieving them through a fine-meshed wire gauze. It is advisable that the plates be covered with as smooth a coating of wax as possible. Otherwise, the filings will be prevented from readily arranging themselves in the directions in which the lines of magnetic force pass.

In the case of powerful electromagnets care must be taken to avoid a too great motion of the filings to the poles, since, in this manner, the portions of the surface over which the particles are moved, are swept clean of filings.

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[1] Read before the Electrical Section of the Franklin Institute on May 31, 1892.

The best results are obtained by sieving the filings over the plate through a sieve whose meshes are sufficiently fine to ensure a small quantity only of filings falling on the plate at any one time. This, of course, is necessary to ensure the uniform distribution of the filings in the field of the magnet.

When the plates on which the magnetic fields are so fixed, are used for positives for photographic reproduction, and negative prints obtained therefrom in black, as by means of a silver print, or a platinotype, such prints can readily be used for the purposes of graphic reproduction for printing by any of the well-known photographic processes. In this way cuts and illustrations of actual fields can be readily had for purposes of illustration, without the introduction of those well-known errors arising from the too great artistic imagination of the copyist.

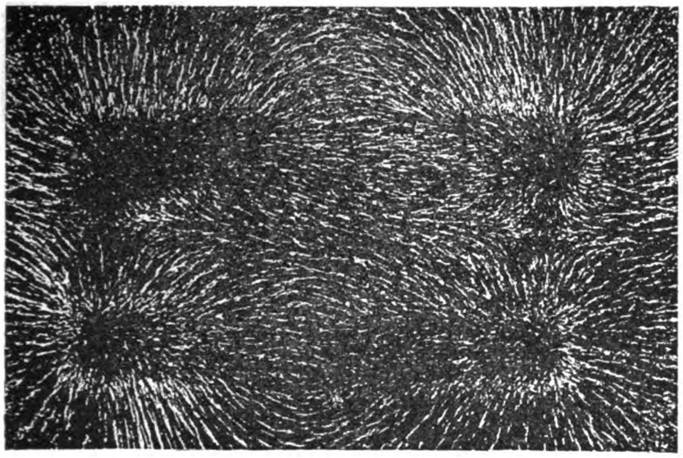


FIG. 5.—PARALLEL BAR MAGNET. SIMILAR POLES OPPOSED.

For purposes of subsequent reproduction I find platinotype paper the best, as it gives dead blacks, that contrasting markedly with the white lines and spaces occupied by the iron filings are readily photographed by any of the well-known processes of reproduction.

When the filings are dusted over the plate from a sieve held a few feet above the waxed surface rather than quite near its surface, a better grouping of the filings is obtained.

I have prepared a number of fields according to the processes described. They have been printed by the platinotype process.

In Fig. 1 is shown the field of a straight bar magnet. The characteristic radiation of the lines of force at the poles is well shown, as well as the curved lines produced by the mutual attraction of the lines coming out of the north and proceeding toward the south pole. The numerous parallel lines at the equator of the magnet show the strength of the magnetic flux at that point.

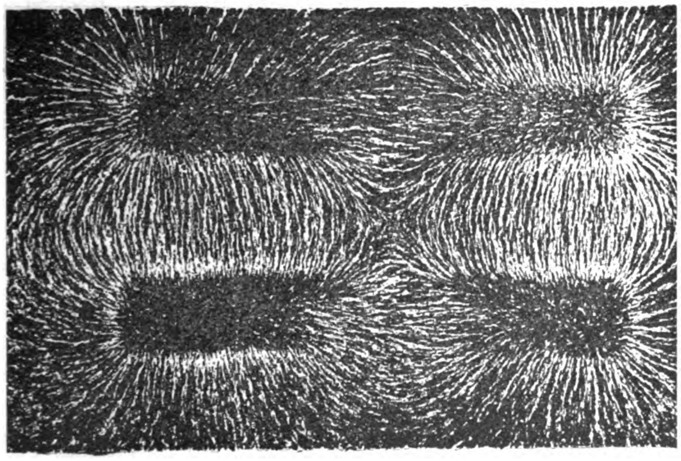


FIG. 6.—BAR MAGNETS. DISSIMILAR POLES OPPOSED.

Fig. 2 shows the field produced by the approached, unlike poles of two straight bar magnets. The attraction of the oppositely directed lines of force in the space between the opposing poles, as well as the increase in the length of space on the bars from which the lines pass off approximately at right angles to the surface, are well marked.

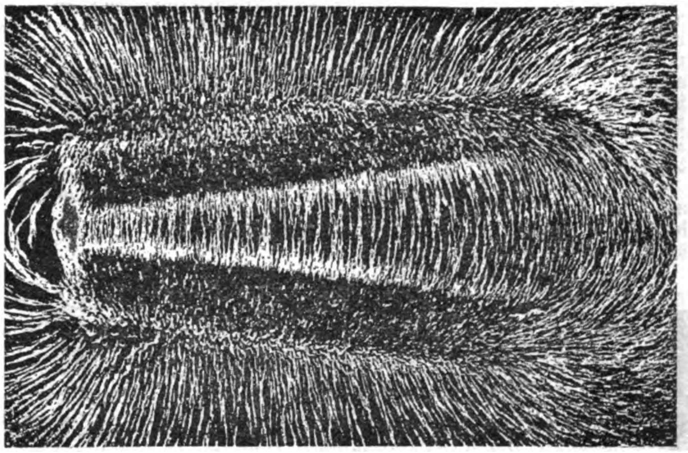


FIG. 7.—FIELD OF HORSESHOE MAGNET.

Fig. 3 shows the field produced by the approached, similar poles of the same straight bar magnets used in Fig. 2. The repulsion of the similarly directed lines of force producing nearly straight paths in lines at right angles to the length of the magnet, as well as a curious space midway between the poles, bounded by apparently hyperbolic curves are clearly seen.

Fig. 4 shows a very curious field produced by two bar magnets placed with their axes at right angles to each other so that one of the poles of one magnet is placed at right angles to the neutral point of the other and at a short distance from it. At the left hand of the field is shown the curved deflections of the lines of force produced by the attractions of opposite poles. The lines of force coming out of a north pole and those entering a south pole mutually attract one another and produce curves similar to those shown in the space between the approached, opposite poles shown in Fig. 2. At the right hand of the field the repulsions existing between the similarly directed lines of force produced characteristic parallel streamings. The curious area bounded by hyperbolic curves is shown in the space between the poles at the right of the figure.

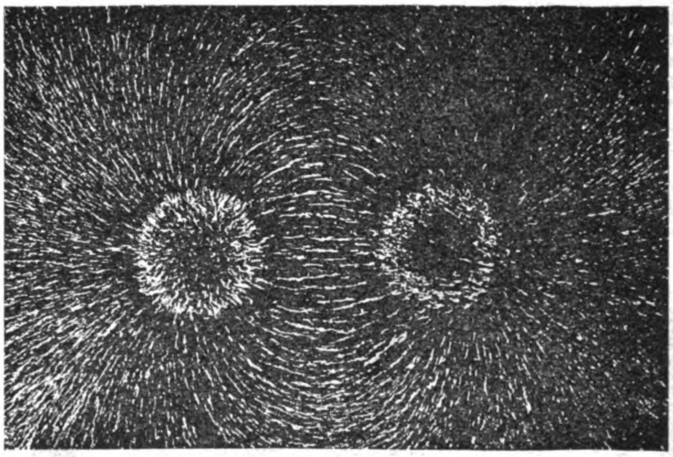


FIG. 8.—FIELD OF ELECTROMAGNET.

Fig. 5 shows the field produced by two straight bar magnets placed with their axes parallel to each other and their similar poles near together. The mutual repulsions of their fields are clearly shown. The curious areas bounded by hyperbolic curves are shown in the spaces at each end between the poles of the magnets.

Fig. 6 shows the field produced by the same parallel bar magnets placed with their opposite poles near together. The attraction of their oppositely directed lines of force is well marked. In the neighborhood of their neutral points, a very marked area bounded by hyperbolic curves is seen. The strength of the magnetic flux near the neutral points is also marked.

Fig. 7 shows the field of an ordinary horseshoe magnet. The magnetic leakage between the sides of the bar is marked, as is also the strength of the magnetic flux in the neighborhood of the equator or neutral point of the magnet.

Fig. 8 shows the field of an electromagnet. In order to avoid the injurious sweeping action of the particles as they are carried bodily forward towards the poles, I found it necessary to use a very weak current, and to place the plate a short distance above the poles. It may be mentioned in this connection that it is in general advisable to avoid resting the plate on the surface of the magnet, since when the plate does not touch the poles it is left free to be gently tapped or vibrated so as to permit the filings to arrange or group themselves while in the field of the magnet.

Fig. 9 shows the field of a peculiarly shaped permanent horseshoe magnet taken in a plane over the poles at right angles to the length of the magnet. I was rather surprised in this case to find that so many of the lines of force passed through extended air circuits shown, rather than through the narrow gap directly between the poles.

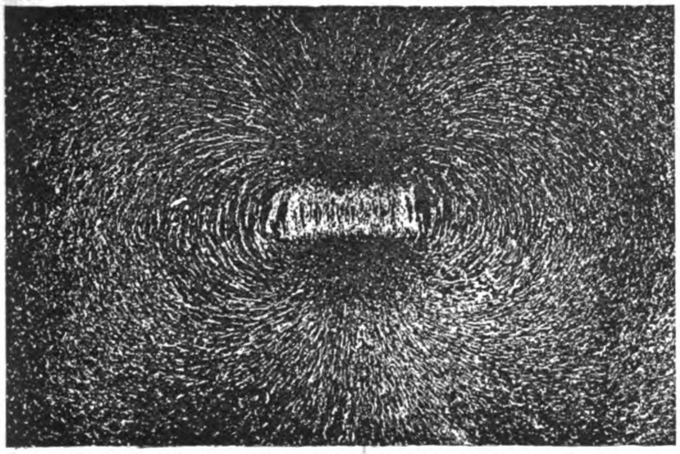


Fig. 9.—Field of Permanent Horseshoe Magnet.

Fig. 10 shows a novel field obtained by short lengths of very thin iron wire, that act as small magnetic needles. The field is that of the bar magnet employed in Fig. 1. Although the separate particles do not possess as great freedom of motion as the shorter and smaller iron filings, yet their tendency to come to rest with the lines of magnetic force passing through their greatest dimensions, so as to reduce the resistance of the magnetic circuit as much as possible, is manifest. The peculiar wire field produced by these means is of especial interest when studied in the light of Ewing's theory of magnetism.

Fig. 11 shows another wire field produced by the same electromagnet as is employed in Fig. 8. The polarization of the minute magnetic needles and their arrangement in groupings of polarized chains is well marked.

Fig. 12 shows a field produced by iron filings and iron wire. The peculiar groupings of the iron wire in chains of polarized particles are clearly shown.

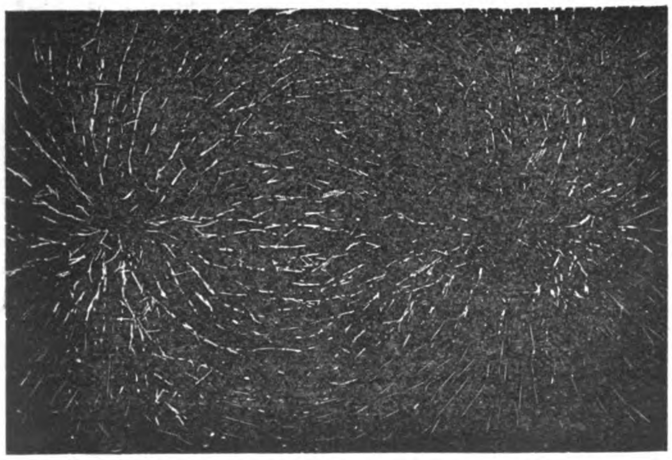


Fig. 10.—Wire Field of Bar Magnet.

A curious resemblance is possessed by this field and other wire fields to the discharge produced by a lightning flash, or other high potential discharge; such, for example, as the recent 500,000-volt discharge of Elihu Thomson. This resemblance quite naturally leads to the speculation, whether the peculiar forked or curved shapes of such discharges are not due to similar causes, viz., to polarized chains of particles of the medium which offers paths of less resistance to the discharge than the spaces adjoining or surrounding them.

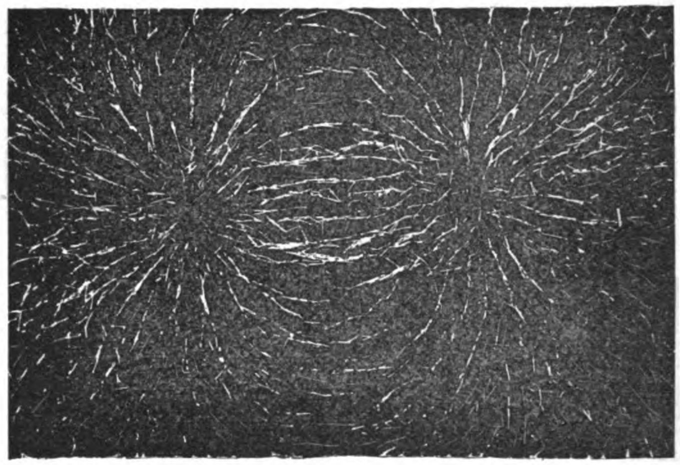


Fig. 11.—Wire Field of Electromagnet.

I am making some experiments in solid fields, *i. e.*, in the peculiarities of the distribution of the lines of force in the space of three dimensions surrounding magnets, which I trust to be able shortly to bring before you.

I desire to express my indebtedness to my assistant, Mr. B. F. Lacy, for valuable aid in preparing the plates.

Since writing the above my attention has been called to the fact that the process above described has been very fully anticipated by Prof. Mayer, in a publication printed in the *Journal of the Franklin Institute*, for May, 1871. As my process differs in some particulars from that described by Prof. Mayer, and as it appears to me advisable to call attention to both processes at this time, I have concluded to permit the paper to go to publication. To Prof. Mayer, however, the credit is due for the first conception of the general process.

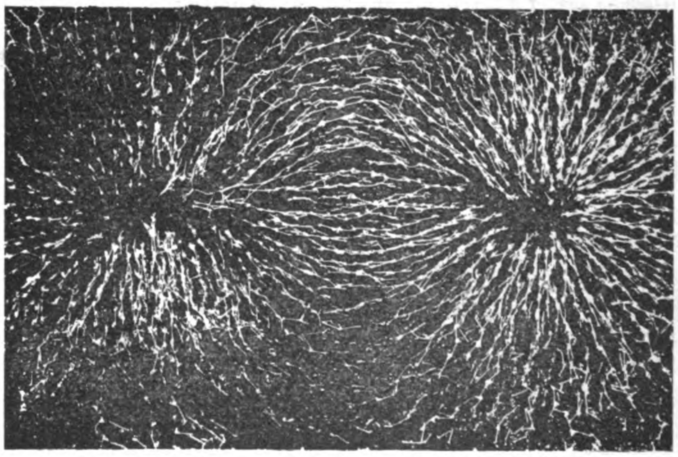


Fig. 12.—Wire and Filings Field.

Since writing the above I have devised a new plan which I believe to be far in advance of what I have just described. According to this plan I place a dry sensitized photographic plate over the magnet whose field I desire to fix and after the characteristic groupings of filings have been obtained, I expose such plate while over the magnet to the light of a gas flame for a few seconds. This operation is necessarily performed in the dark photographic room. After exposure the light is turned out and only the non-actinic red or yellow light left. The filings are allowed to fall off the surface of the dry plate, and the finer particles that still adhere to it are brushed off by a feather or dry camel's hair brush. The plate is then developed and fixed in the usual manner. The removal of the adherent iron dust by the feather or brush is preferable to the use of the breath, as this is apt to produce troublesome spots. I have found that the so-called lightning gelatine dry plates give very satisfactory results when employed for such purposes.

This process of obtaining records of magnetic fields produces true negatives, which when employed for printing by blue print, silver print, platinotype, or similar process produce excellent positives. As the negatives so obtained are more permanent than the positives obtained by the use of the filings themselves, they permit the taking of an indefinite number of photographic prints.

I have thought of forming the field directly on the surface of sensitized paper and exposing such to light. But such paper is apt to curl, and such processes produce but a single impression. The time has been too short to prepare many specimens of fields by this new process. I hope to be able, however, by the next meeting of the section, to present such results in a short paper.

A PRIMARY BATTERY LAUNCH ON THE POTOMAC.

A GREAT deal of interest is being taken in the matter of electric launches, and there is every reason to believe that a great many will soon be seen on American rivers, lakes and ornamental waters. In Europe and England, the number of storage battery launches is already large, but resort to them in this country has been much slower, owing to the initial cost of the outfit and more especially to the absence of charging stations. It is expected, however, that the use made of electric launches on the beautiful and extensive lagoons of the World's Fair at Chicago will lead to the general adoption of such craft all over the continent, wherever a charging circuit is available.

Now that attention has been turned in this direction, it has seemed singular to some that an effort has not been made to utilize the primary battery; and impressed with the idea that something could be done, Mr. Frank Aldrich, of the Hanson Battery, Light & Power Co., determined to equip a launch and run it on the Potomac. We are glad to be able to give herewith illustrations of his launch "Electric," and some account of the manner in which success has been reached. We are indebted to Mr. Aldrich for the figures given below.

The launch, which was built by the Naphtha Launch Co., of Morris Dock, and A. Glose & Son, New York, N. Y., is 21 feet in length and 5 feet beam. She draws 18 inches of water with battery and motor, which are thus, it will be observed, barely sufficient to serve as ballast, instead of being an encumbering dead weight. The propeller is 17 inches in diameter with three blades and makes 250 revolutions per minute. To the propeller is geared a small Riker motor wound for 50 volts and 30 amperes, and weighing 240 pounds. The gear wheels are respectively 2¼ inches and 6 inches. The launch averages 7 miles an hour.

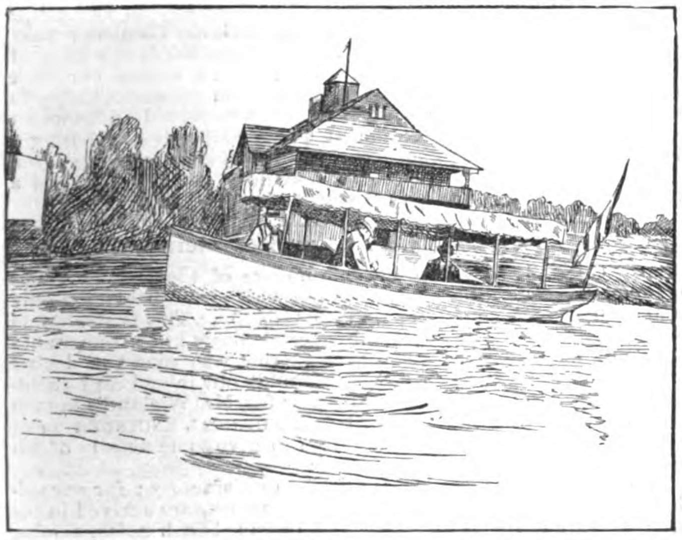


FIG. 1.—THE PRIMARY BATTERY LAUNCH "ELECTRIC."

The battery equipment is very interesting. It consists of 60 Hanson cells grouped as shown in the engraving, Fig. 2, with 30 cells on each side, and so connected that half the required current comes from each row of cells. Each battery box holds two cells. Each cell is 11 x 12 x 3 inches. In each cell is a porous cup 9 x 11 x 1 inches in which is suspended a carbon plate 7 x 11 x ¼ inches. Outside the porous cup are suspended two zinc plates each 7 x 10 x ¼ inches, the surface being thoroughly exposed to the action of the solution. In the porous cup are three pints of strong solution and in the outer cell are six pints of weak solution. The total cost of the solution, including depolarizer, for the 60 cells, is $1.60. From one charge of this battery, Mr. Aldrich gets 180 ampere hours. The cell gives an average of 1⅞ volts, and will yield 50 to 60 amperes on short circuit. The zincs are amalgamated before using, and again after 24 hours' use. The average consumption of zinc is less than one pound per hour when the battery is in use; and when it is not in use the local action is not sufficient to render it necessary to remove the zincs. Each double cell weighs 40 pounds, or 1,200 pounds for the 60 cells, when the zincs are new. The battery cells are of wood treated with a special preparation making them acid-proof.

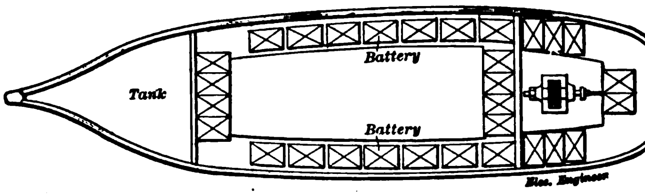


FIG. 2.—PLAN OF PRIMARY BATTERY LAUNCH "ELECTRIC."

From one charge of the solution, Mr. Aldrich gets a good 12 hours' run. In the tank shown at the bow of the boat, he carries extra solution enough for three more charges. The tank is made of prepared wood, as above mentioned, and Mr. Aldrich thinks that it makes a "charging station" that a dynamo and steam engine find it pretty hard to compete with. One man can recharge the whole 60 cells in 1½ hours. Of course the 12 hours of service can be extended over several days, a few hours at a time. The current is thrown on or off by a simple switch that any one can control. The "Electric" seats 12 persons easily, and there is an active competition for seats that keeps her well loaded on every trip.

The Hanson Company has done a great amount of work in and around Washington with its battery and motor outfits, and hence, being well-known its new departure in the launch line has excited very general interest. The trips of the launch have also been watched by the Navy Department, and Lieut. McFarland, U. S. N., has made tests of speed, etc., for Chief Engineer Melville. It is now the intention of Mr. Aldrich to build and equip a launch 30 feet long and 5 feet beam, designed specially for speed, and he hopes to run her at not less than 12 miles an hour. In the meantime, as might have been expected, he is receiving a great many applications for boats from persons who have seen the "Electric" making her graceful, noiseless way up and down the Potomac River.

THOFEHRN'S ELECTROLYTIC COPPER REFINING PROCESS.

M. HYPPOLYTE FONTAINE'S work on electrolysis gives a very full account of M. Thofehrn's process for refining copper by electrolysis. In principle the process does not differ materially from other electrolytic methods, but the arrangement of the parts and the general working out of the details make the method, in the opinion of M. Fontaine, a new, complete and efficient system of copper refining. In the plant at present in operation there are 120 baths in 12 series of 10 each. Each bath is a little lower than the next, and the siphons are placed between them in order to obtain a constant circulation. After the electrolyte has left the last of each series it goes to a collecting basin, from which it is pumped again to the distributing reservoir. Baths are made of concrete. They are lined first with wood, which has been boiled in tar and with sheet lead. The surface of the concrete itself is protected by a coat of a special kind of tar. The electrolyte consists of sulphate of copper, 150 parts; sulphuric acid, 60 parts, and water, 690 parts. In order to oxidize the electrolyte and so remove the impurities which are constantly forming, jets of air are introduced into the collecting basin and the distributing reservoir, and at the same time the liquid is kept at a temperature of 35° C. The rate of production of refined copper is 1 gramme per ampere hour, or in an average of 2½ tons per day. The average drop in potential for each bath is 1.5 volt. The difference in potential at the binding posts of the dynamo is just sufficient to overcome the resistance of the bath and the conductors. The cost of refining copper by this installation is $19.60 per ton. The original cost of the plant was $37,300: the stock in hand has always a value of $84,000, and the annual working expenses are $9,210. The interest on capital and stock and the depreciation amount to $8.130 per annum; this, together with the working expenses, is equal to $17,640.

MR. FRED. SARGENT, the electrical engineer of the World's Fair authorities was in New York last week closing a contract with the Worthingtons for a huge pumping outfit for the Fair, The water required will reach as many millions of gallons as if it were to supply the population of a large city.

Obituary.

CYRUS W. FIELD.

Cyrus W. Field.

THE death of Cyrus W. Field, on July 12, at Ardsley, N. Y., at the age of 73, removes from the ranks of American electrical pioneers the man to whom, more than to any one else, is due the laying of the Atlantic cables and the foundation of submarine cabling as a great modern commercial enterprise. The story of Mr. Field's life and work has been told so often that it long since became hackneyed, but it may be fitting to recapitulate the chief events in his distinguished career. He was born at Stockbridge, Mass, on November 30, 1819, of an old New England family. As a youth he was employed by A. T. Stewart, the great drygoods merchant, then went into business for himself, made money, and at last became interested in a scheme to put a telegraph line across Newfoundland. That naturally led on to the project of an Atlantic cable, which had already been suggested by F. N. Gisborne, then a telegraph operator. Mr. Field had keen foresight, great courage and a genius for organization, and these qualities, as well as his fortune, were soon devoted to the idea which had taken complete possession of him. The New York, Newfoundland and London Telegraph Co. was formed, with the co-operation of such men as Peter Cooper, Moses Taylor and Marshall O. Roberts, and the project was at once pushed on both sides of the Atlantic, Mr. Field crossing the ocean more than forty times in prosecution of it, while preliminary work was successfully attempted in the way of laying a cable between New York and Newfoundland. Two attempts at Atlantic cable laying failed before a cable was actually laid in 1858 and messages were exchanged from shore to shore of the Old World and the New; but the cable snapped at once, and silence again fell, not to be interrupted until July 27, 1866, when, as John Bright said, Mr. Field, as the modern Columbus, had, by his cable, moored the New World alongside the Old. Then, practically, began the development which has to-day resulted in an aggregate of 135,000 miles of submarine cable. Honors came fast and thick to Mr. Field, and a period of financial struggle and stress was swiftly succeeded by one of great riches.

Of late years Mr. Field was interested in other public enterprises, notably the New York Elevated Road, and in this, strangely enough, he lost the bulk of the fortune he had made out of electricity. More recently the failure of his son, Edward M. Field, drained his resources, until at last when he died, Cyrus Field was, it is said, in actual poverty. But of his more solid and lasting acquisitions, no one can rob him, and he will forever remain rich in the esteem of his countrymen and in that of mankind at large, as the great American who, despite all discouragement and delay, had carried to completion and fruition one of the foremost enterprises of the age, that upon which, perhaps, more than any other, the present political fabric of the world depends, while it has done much to improve social intercourse and modify the conditions of commerce.

ELECTRIC LAUNCHES AT THE WORLD'S FAIR.

GENL. C. H. BARNEY writes us as follows from Chicago:

At the official test of electric launches made by the electrical engineers of the World's Columbian Exposition, at Jackson Park, Chicago, Ill., each boat was required to make a ten hours' consecutive run, over a prescribed course, and making designated landings. Two boats entered, the "Electra," owned by the Electric Launch and Navigation Co., of New York, and a boat not named, built by the Columbian Launch Co., of Chicago.

The "Electra" made 45 trips at the rate of 11¼ minutes per trip. The Columbian boat made 32 trips at the rate of 16¼ minutes per trip. Subsequently, a test of several cells of battery, taken at random from the two boats, was had. The cells were charged as fully as the contestants desired and then discharged at the uniform rate of 16 amperes. The Consolidated Co.'s batteries of the "Electra" were charged 160 ampere hours, and gave a discharge of 137. The Columbian batteries (Morrison's) were charged 200 ampere hours, and gave out 100. A second test of the latter resulted: Charge, 235; discharge, 109.

A NOVEL APPLICATION OF STORAGE BATTERIES ON A TROLLEY ROAD.

A MOST interesting exhibition of the application of storage batteries for propelling electric cars was given in Dover, N. H., July 12. At the invitation of the Bradbury-Stone Storage Battery Company, of Lowell, Mass, who made the installation, about 30 gentlemen from Boston and Lowell went up to Dover to witness the test of the application of storage batteries as an auxiliary to the overhead trolley system in that city. The application is extremely novel and very interesting in its details. The road is operated by the Union Electric Street Railway Company, power being furnished from the station of the Great Falls Electric Light Company, situated on the Salmon Falls River. The road is full of steep grades, and in one part about half a mile out of Dover there is a grade of over nine per cent. over the Garrison Hill, which taxes the trolley system to the uttermost at all times, and which on special occasions when the cars are heavily loaded, proves too much for the trolley system to overcome. In the past on such occasions it has been found necessary to employ from four to six horses to aid the electric car in surmounting the grade. The station from which the current is derived is a number of miles away, and much speculation has arisen as to the inability of the cars to surmount the grade. It is accounted for partly owing to the long distance between this hill and the station, and the necessary fall of potential when a car is drawing heavily on the current on the hill. The natural objection to keeping horses at this point led Mr. H. W. Burgett, the general manager of the road, to investigate other methods, and after consulting with Mr. J. T. Bradbury, of the Bradbury-Stone Company, it was at last decided to try storage batteries as an auxiliary. Accordingly in a small outhouse, attached to a house in the vicinity, 238 cells of storage battery were installed. The cells are all connected in series and give a total voltage of from 530 to 540 volts. The trolley wire on the hill was cut off from the remainder of the system, and wires leading from the storage battery were connected to it, so that as soon as the car trolley wheel, comes in contact with this section, which is about 300 feet long, the current is all taken from the batteries. The experiment worked most successfully, the volts only falling off five or ten, when the motors were drawing from 40 to 60 amperes. On Tuesday a very crucial test was made. The special car containing about fifty people was hitched on to one of the regular trip cars, also well loaded, the one car pulling the other, and both ascended the hill without a hitch, the battery registering about 510 to 520 volts, and the current being consumed from 100 to 1[illegible]0 amperes. Mr. Burgett is to be congratulated on his "happy thought" in introducing this auxiliary in the shape of a storage battery, and the Bradbury-Stone Company may well be congratulated upon the extremely successful working of their battery. After visiting the installation, a special car took the visitors to Burgett Park, one of the numerous tributaries to the electric road, where a light lunch was served, afterwards visiting the interesting station at Great Falls. On returning a most enjoyable dinner was served by the Bradbury-Stone Company to their guests, in one of the pavilions in the park, and a return was made to the city about 7 o'clock.

AN ELECTRIC LAUNCH IN THE PACIFIC.

MR. CHAS. S. WIELAND, the commodore of the Pacific Yacht Club, is the owner of a storage launch which is probably the only one in this country now in actual commission. This is strange in view of the popularity enjoyed by electric boats in Europe and in England, but there is reason to hope that very soon the electric launch will soon be a familiar sight on all our inland and yachting waters. In order to ascertain how far Mr. Wieland's launch had proved satisfactory to him, THE ELECTRICAL ENGINEER wrote to San Francisco recently asking him to give some details of his experience. His reply is as follows:

"My experience has been more than satisfactory; far exceeding my highest anticipation. The extreme pleasure derived in the use of this power is its not being attended with noise, smoke, grease or unpleasant odors, aside from the novelty. The electric launch "Magnet" was built and designed by Frederick Reckenzaun, New Jersey, and shipped direct to California to me. The "Magnet" is 28 feet over all, 6 feet beam and 30 inches draft. She carries 56 batteries, "23 M" type, which operate a Reckenzaun motor 2½ h. p. On one full charge of the accumulators the "Magnet" will run 10 hours at the rate of eight miles an hour, and for spurts can attain the speed of 12 miles.

"This "Magnet" is operated with the ease of a boy with a miniature boat in a tub. By the turning of a lever the speed can be regulated. She has electric whistles and a 100 c. p. search light at the bow and 16 c. p. side lights of red and green as well as 12 incandescent various colored lights suspended from the awning. I have a power house on the grounds of the Pacific Yacht Club, from which the "Magnet" is charged by an Edison dynamo.

"If I have not made myself clear on this or any other point connected herewith it will be a pleasure to me to furnish you with any additional data. I am so well pleased with electric motor applied to yachting I have in contemplation in the near future arranging for another launch on a much larger scale."

Letters to the Editor.

DR. JACQUES' EXPERIMENTS IN THE LIGHT OF MAXWELL.

I AM sorry that Mr. Victor M. Berthold should think that I wrote in a spirit of pugnacity, if he means pugnacity toward himself or Dr. Jacques, for, as I do not know either of these gentlemen personally, it is impossible that I should have any such feeling toward either of them. If, however, he means pugnacity toward the paper published under the name of Dr. Jacques, he expresses exactly my feelings, which would not be any different if the paper had borne the name Thomas Jones or Samuel Smith. I am also sorry to have caused him such alarm in regard to my ignorance, but I am not to blame; it is all owing to a typographical error.

The objectionable passage should read "the attraction of *oppositely* electrified plates," which makes sense of what I meant to write, whereas the way it was printed made nonsense. This I had supposed was so evidently a typographical error that I did not think it necessary to write a special letter of explanation any more than in case of the misspelling of a word.

Now if the published report of Dr. Jacques' paper is correct, he expected and obtained (?) an increase of attraction between oppositely electrified plates, where, according to Maxwell's view of the subject, the attraction should be diminished in the same degree as the repulsion of the similarly electrified plates is. Maxwell says: "This moving electrified surface will be equivalent to an electric current sheet." I have already quoted this, but take the liberty of requoting it as Mr. Berthold in his letter leaves it to be inferred that the experiment tried by Prof. Rowland, and described in Maxwell, Art. 770, was the only one founded on that assumption. The above quotation, however, is from Art. 769, where the experiment which Dr. Jacques is supposed to be trying, or at all events improving upon, is described.

Two parallel, similarly electrified surfaces, by virtue of their electrostatic properties repel; but when moving in the same direction they (that is, the electrified surfaces) are, according to Maxwell, equivalent to two parallel conducting "sheets carrying currents in the same direction, and, therefore, by virtue of their electromagnetic properties, will attract." At a certain velocity, namely that of light, the attraction and repulsion will balance. This is Maxwell's idea, the moving electrified surfaces are equivalent to conductors carrying currents; and yet Dr. Jacques deliberately leaves Maxwell at this point and says that the ether current passing between the plates is the electric current, and Mr. Berthold will have it that this is in accord with Maxwell. I think these gentlemen differ with Maxwell by a much larger discrepancy than I do.

In the case of two oppositely electrified surfaces moved in the same direction we have the equivalent of two parallel conducting surfaces carrying currents in opposite directions. The electrostatic action will be attraction, and the electromagnetic, repulsion, again tending toward equilibrium, where Dr. Jacques thinks both should be attraction.

As to the charge of setting myself up in opposition to Maxwell, I must plead guilty. This may indicate that I am very audacious, perhaps very egotistical; but I will say for myself that I am susceptible to conviction by argument, but that the mere assertion of the fact that I differ with Maxwell is not argument. I think I thoroughly appreciate Maxwell's genius and noble character, but I cannot find that he ever made any pretentions to infallibility. On the other hand he himself corrected in the second edition of his work several errors which he had found in the first edition, and had he lived to the present time he would have probably found other errors in his work and corrected them in the third edition. It is even possible that he would have changed Art. 769. My reason for hazarding this rash assumption will presently appear.

I am happy to say that I agree with Mr. Berthold in one thing, that Maxwell describes in Art. 769 the motion of two electrified surfaces relative to some fixed point in space; that is, relative to space itself, which is nothing more than absolute motion in space. Maxwell says in his little work on Matter and Motion, (I quote from memory as I have not the work at hand): "Any one who has once tried to conceive of absolute motion and absolute position in space, will ever after be content with relative ideas."

It may be that this Art. 769 of Maxwell does not involve the idea of absolute motion in space, in which case I will be pleased if Mr. Berthold or any one else will demonstrate that fact.

BROOKLYN, N. Y. TOWNSEND WOLCOTT.

"LEONARD'S THREE-WIRE SYSTEM."

I HAVE noted Prof. Elihu Thomson's letter, published in your issue of July 6th. The question under discussion can only be understood by careful examination of Mr. Rice's patent and mine, but for the benefit of any readers who may take sufficient interest to examine into the matter, I call attention to the following:

Prof. Thomson says: "Mr. Leonard might easily have discovered that the reversal of the field which he lays so much stress upon, means the reversal of the current in the series field." There can be no question that this is what the patent should have said, and it might have been well to add that the less of this series coil we have the better, and that the best result will be obtained by leaving it off entirely. But this is not what the patent *does* say, nor intimate, but on the contrary the greatest stress is laid upon the action of the series coil, and most of the specification is taken up with a discussion of its performance.

In my former letter I called attention to the fact that the reversal of the field was emphasized several times, and claimed distinctly.

Prof. Thomson says of this: "This is decidedly not true." In reply to this statement which would give the reader the impression that I had made my statement without any foundation of fact, I quote from the patent the two following paragraphs, which leave no room for doubt in the matter.

"So that a reversal of the field will occur, and the equalizing machine, becoming a generator, deliver current, etc."

"Said machine being so wound that its field is reversed, according as the shunted side has the lighter or heavier load, thereby causing it to act both as a motor and generator, as set forth."

There can be no question of the fact that any reader of the specification would suppose that the reversal of the field was an essential feature, controlling the change from a motor to a generator, whereas the change from acting as a motor to a generator, and *vice versa*, is totally independent of the effect of the series coil.

At line 100, page 1, of the patent is the following: "The field magnetism of the equalizing machine will be varied in accordance with variations of load in the two multiple arc groups." This statement is clear and unquestionable, yet it will be evident that the field magnetism of the equalizing machine for an operative plant should be totally independent of the variations of the load in the two groups, and that the drop in the conductors is the only cause demanding any change in the field magnetism. The drop in the conductors is not mentioned in the patent, and the series coil was not intended to take care of the drop but to "thereby cause it to act both as motor and generator."

Nowhere is it stated in the patent that the series coil can be dispensed with. No drawing is without it. In fact, every point emphasizes the important functions of this coil which is to cause the reversal of the field.

Further evidence to the same effect is contained in the two later patents of Prof. Thomson and Thomson and Rice, which describe methods of getting over the very difficulties which will necessarily be met with in attempting to operate any system having the series coil upon the equalizing machine.

The most positive way to settle such a question is to try it in practice. The commercial use of my system has proven that the series coil is entirely unnecessary. Upon the action of this series coil Mr. Rice's patent depends.

Prof. Thomson does not say that it has been tried commercially. This seems odd in view of the tremendous interests dependent upon avoiding the Edison 3-wire patent, which, until the recent consolidation, was so threatening to the Thomson-Houston interests.

H. WARD LEONARD.

NEW YORK, July 11, 1892.

Literature.

Eclairage Electrique. Monographie des Travaux Exécutés par le Syndicat International des Electriciens. By Hippolyte Fontaine. *Paris, Baudry & Cie.* 1890. 200 pages, 8½ x 12 inches. Price $10.

IT has come to be a generally recognized fact that the only proper mode of illumination for World Exhibitions, at the present time, is that which can be afforded by electricity, and this was strikingly exemplified in the action of the management of the Chicago World's Fair, which did not for a single instant entertain any other proposition. The magnitude of the illumination to be effected at Chicago is such that any ideas which can be brought forward as to the methods best adapted for work of this kind must be of value, and as such we think no better example can be afforded than the lighting work carried out at the Paris Exposition of 1889. Fortunately an account of the work there accomplished has been gathered together in the volume before us. Under the able and impartial editorship of M. Hippolyte Fontaine, it affords an excellent record and a storehouse of information on exposition lighting methods.

It will be remembered that, unlike the arrangement adopted at Chicago, the lighting of the Paris Exposition was farmed out, as it were, to a syndicate, composed of all the leading electric lighting companies in France, Belgium and Switzerland, and of firms in England, Alsace and Switzerland, and as a result we find a great variety of apparatus in operation at the exhibition. The work gives a complete history of the organization of the syndicate and its arrangement with the Exposition authorities, and then proceeds to describe the installations of the various companies and the apparatus employed by them, giving many details and drawings of dynamos and arc lamps, and thus affording an interesting record of the state of the art in France at that time. We also find a full description of the electric fountain, which was one of the greatest attractions of that exhibition, and various methods of suspending arc lamps in order to obtain the best distribution of light and also means for readily raising and lowering lamps for trimming.

We also note the cost, to exhibitors, of electric lights, which was as follows, the price given being the total cost for wiring and maintaining the lamps during the entire exhibition time: 16 c. p. incandescent lamps 60 francs each; 10 c. p. lamps 45 francs; arc lamps, 500 c. p., 500 francs; arc lamps, 1,000 c. p., 750 francs. This cost was calculated on a basis of 900 hours' burning for each lamp; beyond that time the price was, respectively, .05 franc, .03 franc, .75 franc and 1 franc.

The cost of power up to 500 h. p. hours was .5 franc per electric h. p. hour, or beyond 500 h. p. hours .4 franc. The work now being carried out in Chicago must of necessity be of a character similar to that accomplished in Paris, and for all those engaged in it, as well as those interested in exhibition lighting in general, the volume will prove of great value. The book is fully illustrated by 29 large plates and 32 excellent engravings in the text.

Personal.

Mr. C. D. Shain has resigned his position as manager of the Eastern District of the General Electric Company. This district, under the old regime of the Edison Company was large and did an enormous business, and its success was due in a considerable degree to Mr. Shain's vigor and skill in executive work. Mr. Shain is very reticent as to his future course, but is understood to have received several flattering offers already. His experience in all departments of the electrical field is so large as to make his services of rare value to the concern lucky enough to enjoy them. It is said that Mr. Shain will be at liberty September 1, and his next step, in these stirring times, will be awaited with considerable interest and curiosity.

Mr. H. V. Wille, class of '92 of the Cornell Department of Electrical Engineering, and Mr. E. S. Cary, of Haverford College, class of '92, have accepted positions on the electrical staff of Queen & Co. of Philadelphia.

Mr. Edwin H. Northrup, of Amherst and Cornell colleges, late of Queen & Co., has been appointed Junior Fellow of Physics and Docent at Clark University, Worcester, Mass.

Mr. A. W. Schramm will leave the staff of Queen & Co. this fall to take up the duties of instructor in electrical engineering at the University of Pennsylvania.

Mr. W. D. Weaver, of E. G. Bernard & Co., is resigning to assume a position in the business office of *The Electrical World.* His familiarity with electrical engineering matters will render him very valuable.

Legal Notes.

ALLEGED STEALING OF ELECTRIC CURRENT IN ST. LOUIS.

Gustave Temple, the first man tried on a charge of stealing electricity, has been discharged from the St. Louis Court of Criminal Correction. The judge would not concede that it was petit larceny and the Grand Jury would not allow that it was fraud, so when the case came up Attorney McDonald, for Temple, entered a plea for formal acquittal, which was concurred in.

Temple, who is a hardware dealer, was accused of having tapped a wire of one of the electric light companies to get his illumination free.

A DECISION IN FAVOR OF SWAN ON PAPER FILAMENTS.

The Commissioner of Patents has decided a long-standing controversy between Thomas A. Edison and Joseph W. Swan, as to the priority of right to a patent for an electric-light carbon for incandescent lamps. The dispute had been pending since 1881. Swan laid claim to having invented the parchmentized paper in March, 1880. He filed his application in April following, and the patent was issued in October following. Edison did not file his application until May, 1881, but he said that he had made and used the invention as early as 1879. In 1881 Edison filed the following issues of interference:

> "1. A carbon formed from a straight strip of cardboard paper or parchment paper, and bent to the form of an arch, hoop, or loop, and carbonized by heat while in a bent condition.
>
> "2. A carbon for an electric lamp made of the carbonized parchment paper."

On these, testimony was taken on both sides, and for a time a spirited legal battle was waged. For some time the case has lagged, not being considered of any material commercial value.

Society and Club Notes.

ANNUAL MEETING OF THE NEW YORK ELECTRICAL SOCIETY.

The annual meeting of the New York Electrical Society was held at the Electric Club on July 14, at 7:45 p.m. A prosperous year was shown, the membership having grown from 264 to 292, while the finances are in a sound condition. It was voted that the Society present an honorarium to Mr. Guy, the efficient secretary, who has so long given his services without compensation. It was also voted that the executive committee should be asked to consider the question of lower dues, as connected with an active recruiting of new members. Thanks were tendered to the old officers, and the following ticket for 1892–3 was then unanimously elected: President, Joseph Wetzler; vice-presidents, Prof. F. B. Crocker, Nikola Tesla, J. J. Carty, Charles Cuttriss, T. R. Taltavall and R. S. Dobbie: treasurer, H. A. Sinclair; secretary, George H. Guy.

The Society then adjourned to Madison Square Garden, where about seventy of the members, many of whom were accompanied by ladies, witnessed the performance of "Sinbad," with its wonderful electric light effects, and then enjoyed the concert in the roof garden. The evening was a great success, and added one more to the long list of special entertainments that the Society is so successful in organizing.

THE CLAMBAKE OF THE YEAR.

The Fourteenth Annual Rhode Island Clam Dinner tendered to the electrical fraternity by the American Electrical Works of Providence, R. I., will be given at Haute Rieve, the Union Club country house, on Saturday, July 23, 1892. Lunch will be served at 11.30 and the bake will be opened at 2. As usual, a delightful time may be expected by the veterans and new recruits who hasten to accept the royal hospitality of President Sawyer and his associates.

WESTINGHOUSE ROADS IN NEW ENGLAND.

Mr. R. S. Brown, electric railway representative of the Westinghouse Electric and Manufacturing Co., reports an active demand for apparatus. Among orders recently filled is one for the Natick and Cochituate Street Railway Co., who have equipped and are running four cars with 25 h. p. motors. They are taking current from the electric light station. The road is to be extended to Saxonville.

The Wakefield and Stoneham Street Railway Co. have equipped with four cars, each having two single-reduction motors of 20 h. p. The road is 3½ miles long at the present time, but with extensions will reach about seven miles. It will take current from the local electric light station.

The Fitchburg Street Railway, which has eight cars with Westinghouse motors, is running splendidly. The road has now been open about two months and has been carrying great crowds of passengers all the time.

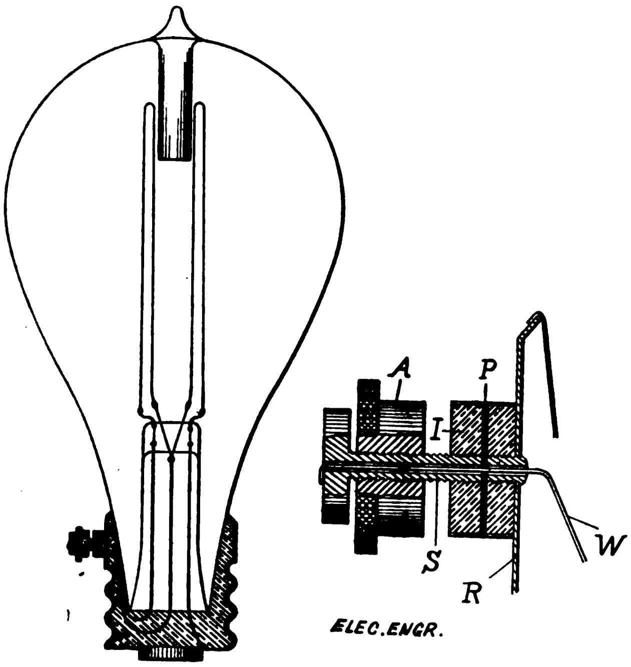
On the 4th of July the Worcester Consolidated Street Railway Co. did an enormous business. Two of its Westinghouse cars earned $100 each. On the whole road they took in $900 more than had ever been paid in fares before. The cars are 36-footers, and one of them during the 4th had on board 185 adults, almost every woman in the crowd having at least one child with her. The capacity of the electric cars is never underrated by the passengers.

QUEEN & CO.

A number of additions to their business and technical staff have lately been made by Queen & Co., of Philadelphia, the better to keep pace with their growing business in electrical instruments. Mr. Nelson H. Genung, a graduate in electrical engineering, of Cornell, has accepted a position in the Queen laboratory, at Ardmore, and his time will be largely spent in designing new instruments and assisting in original work.

THE EDISON NIGHT LAMP.

It is often desirable in interior illumination to run lamps considerably below their normal candle power, as for instance in the case of hall lights burning all night, or in sick rooms and bed-chambers. To accomplish this without loss of energy due to the introduction of external resistances, on direct circuits, the Edison General Electric Co. have brought out what is known as their "night lamp," which is illustrated in the accompanying engraving, Fig. 1.



Figs. 1 and 2.—Edison Night Lamp.

The lamp, as will be seen, is provided with two filaments connected up in the manner shown, and provided with a special switch at the top of the base, which is shown enlarged in Fig. 2. This small auxiliary switch consists of a short brass tube soldered to the screw ring of the lamp and encircling the screw s, the space between the tube and the screw being filled with insulating material I, and the screw s, being kept from turning by means of the insulating pin P. The screw s, is hollow and through it passes the wire w, which is connected to the filaments, which are joined at the centre of the stem.

Mounted upon screw s, is a brass nut A, which, when screwed up, makes connection between the screw s, and the short brass tube soldered to the screw ring. This evidently connects the wire which is soldered to the screw ring of the base R, to that joined to the ends of the filaments at the centre of the leading-in tube, thus short-circuiting one carbon, and allowing the other to give its full brilliancy. When the nut A is screwed back and in the position shown, both the carbons in the lamp are in series and burn at only a fraction of the normal candle power of the lamp. These night lamps as a rule are frosted and shed a mellow light about the apartment.

AN EXTENSIVE SYSTEM OF ELECTRIC ROADS FOR NEW YORK CITY.

The consolidation of the North Third avenue and Fleetwood Park Railroad, the Melrose and West Morrisania Railroad, and the Harlem Bridge, Morrisania and Fordham Railway Company has been completed. This is the combination of horse railroads commonly spoken of as "The Huckleberry Road." Its new corporate title is the Union Railway Company of New York City, and it has $2,000,000 of capital stock, which is more than double the capital stock of the three companies. Following are the names of the directors elected recently: Charles A. Stadler, William Cauldwell, John C. De La Vergne, Thomas W. Olcott, James W. McNamara, and Edward A. Maher of New York; Anthony M. Brady and Robert C. Pruyn of Albany; Albert Shaw of Troy.

The executive officers are: President, Edward A. Maher; vice-president, Charles A Stadler; secretary and treasurer, Thomas W. Olcott.

About seventeen miles of this Union Railway are now in operation by horse power. It is expected that by next November the the entire seventeen miles will be operated by the trolley system. Eight miles of new road will be constructed without delay, making twenty-five miles of road, (all on the trolley plan) which will traverse in many directions the territory lying between the Harlem River and the Westchester county line. The change to the trolley on the main artery will probably be made before the end of August.

The new company will issue bonds not to exceed $3,000,000, to pay for the trolley and the construction of the additional line of road.

THE METRIC SYSTEM IN THE UNITED STATES.

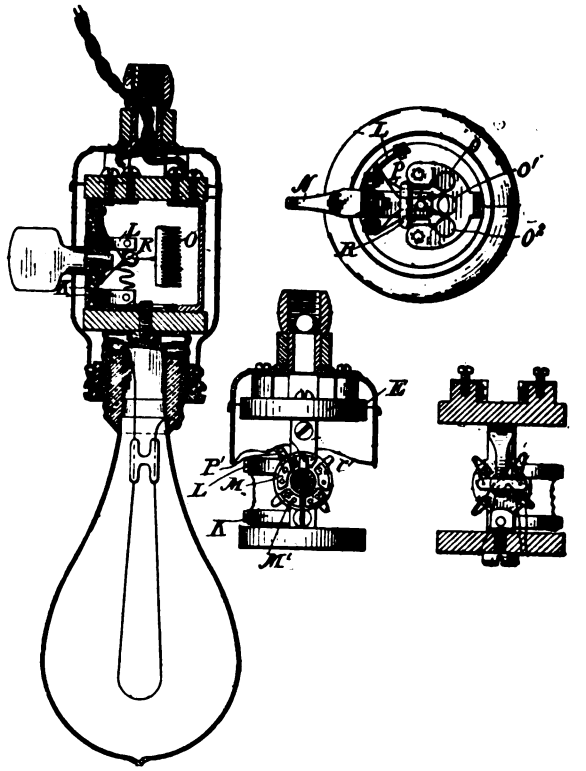
A circular, issued by Prof. John K. Rees, secretary of the American Metrological Society, states that the American Metrological Society has prepared a petition asking Congress to pass the following act:

"That on and after July 1st, 1893, the metric system of weights and measures authorized by the act of Congress approved July 28th, 1866, shall be used exclusively in the customs service in the United States."

Such petition the society desires to circulate widely among those desiring to sign it, and it asks each signer to mail it to his representative in Congress. The American Metrological Society has prepared a simple and excellent chart of the metric system which, for educational purposes, it will mail to any one asking for it for the cost price, 10 cents in stamps. Address secretary of American Metrological Society, No. 41 East 49th street, New York City. Copies of the petition can be had at the same address.

THE WERLINE REGULATING LAMP SOCKET.

The desirability of varying the brightness of an incandescent lamp at will is so obvious that it needs no discussion at this late day. With the object of affording a compact lamp socket, which should contain the necessary regulating device, Mr. Henry E. Werline, electrician of the Werline Electric Specialty Co., of York, Pa., has just brought out the socket illustrated in the accompanying engravings. As will be seen, the handle by which the lamp is turned on and off carries a series of contacts, M, M′, etc., which connect with a corresponding number of carbon helices, O, O′. These small helices are kept apart and thoroughly insulated, and in order to prevent too strong a current from passing through them, by which they might be heated and consumed, they are protected by short fuse wires. The entire set of helices is so mounted that, together with the switch handle, they can be entirely withdrawn from the socket by removing two screws. In this way the socket can be readily inspected at any time. By the protection thus offered to the carbon helices and their arrangement, the use of expensive platinum is avoided and a cheap and effective regulating socket can be produced. At the same time it does away with the necessity of a vacuum chamber for containing the helices.



Werline Regulating Lamp Socket.

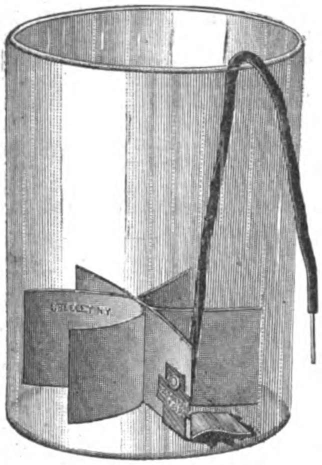
TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

Everything comes to him who advertises.

THE GRAVITY COPPER ANCHOR.

THE illustration herewith shows a very valuable improvement which has been lately made in the gravity battery copper, consisting of an anchor attachment for securely and permanently fastening or anchoring the copper to the bottom of the glass jar. The liability to displacement of the copper electrode has always been a serious obstacle in the way of getting the best results from the popular gravity battery.



GRAVITY COPPER ANCHOR.

The new device shown prevents effectually the copper from rising above the bluestone. The copper being held firmly on the bottom of the jar, a uniform distance is had between the two electrodes in all the cells of a battery, and consequently uniformity of resistance throughout, with the highest efficiency.

The "anchor" is made of a piece of sheet copper with a coat of adhesive compound or cement on one side, the upper end being riveted to the electrode, together with the copper connecting wire. When packed for shipping the anchor is rolled up in the shape of a cartridge, with the cement on the inside.

To apply the anchor it is simply necessary to unroll the cartridge, bend it back at right angles parallel with the bottom of the jar, slightly heat the cement over the flame of a match or lamp, and the strip is then ready to be pressed down against the bottom of the jar into position. A little cold water is sufficient to chill and set the cement.

Thus fastened, the cohesion of the cement is sufficient to stand a strain on the wire equal to many times the weight of the jar without dislodging the anchor.

This new copper is now being placed on the market by The E. S. Greeley & Company, sole agents. A patent has been applied for on the device.

NEW YORK NOTES.

MR. **NORMAN HUBBARD**, of No. 93 Pearl street, Brooklyn, N. Y., manufacturer of the Packard vacuum pump, reports that there are now upward of 150 of these pumps in use in incandescent lamp factories in this country and abroad. Among recent shipments are one No. 3 pump to the Edison Lamp Company, Harrison, N. J., and one No. 3 and one No. 4 to the Dominion Electric Company of Montreal, Canada. Recent improvements in the Packard pumps have rendered them capable of continuous use without any danger of break-down or a diminution in the uniformly excellent vacuum they produce.

MR. **E. E. RIES**, president of the Ries Electric Specialty Co., was in New York last week. He reports that the company are not only very busy with their celebrated regulating socket, but are now preparing some new and valuable lighting specialties for the market. Mr. Ries is also very sanguine as to the ultimate success of his induction railway system, which dispenses with all overhead wires, slots or contacts. The model road in the company's factory works like a charm, and Mr. Ries is now after an opportunity to give the system an open-air test.

THE ASTORIA ELECTRICAL MANUFACTURING CO. are running a storage battery car daily on the Steinway & Hunter's Point Railway with a new type of battery weighing 27 lbs. per cell where the usual types of the same capacity weigh 40 lbs. per cell. The battery stands heavy discharges with very small drop in voltage and is therefore well adapted to car work. The positive grids are more durable than those of the usual types, as they are not attacked by the acid and are elastic enough to expand without breaking. The performance of the car is perfectly satisfactory, and the company are going ahead on a commercial basis and are already negotiating with three different roads with a view to equipping them with battery cars.

MR. **LUKE LILLEY**, who for some time past has been the city electrician of Cincinnati, but is now out in the field again for himself, owing to recent changes in city affairs, was a caller in New York last week. Mr. Lilley was one of the pioneers in commercial electric lighting, and has an unequaled fund of experience. He has already had several offers to engage in lighting and railway enterprises, but may spend a little time in developing two meritorious inventions that he is interested in.

PROF. GEO. D. SHEPARDSON, of the Department of Electrical Engineering, University of Minnesota, has been spending his vacation in the East. After visiting Cornell, he made his way to New York last week and looked up a number of friends in the trade and profession. He is mapping out a very interesting line of work for his electrical classes in the fall.

THE EDISON MANUFACTURING CO., which handles the Edison Lalande battery, etc., has removed its offices to 110 East 23d street, this city, where all communications should be addressed. Mr. A. O. Tate is general manager.

HALL & BURDICK are a new firm who have established an electrical supply business at Dansville, N. Y. They find a good opening for local trade and bid fair to succeed.

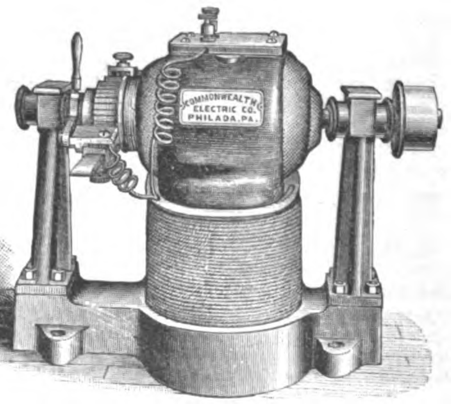
PHILADELPHIA NOTES.

MR. **NEWTON D. HARSH**, formerly with the electric light company at Lancaster, Pa., has opened a wholesale and retail electrical supply house on the third floor of 17 Centre Square, that city, where he will carry on a general electrical business.

CAMPBELL & ZELL CO., of Baltimore, Md., makers of the Zell improved safety boilers, etc., write us that Mr. Robert R. Zell is no longer connected with the active management of their company.

THE COMMONWEALTH DYNAMOS AND MOTORS.

THE accompanying illustration shows the generator of the Commonwealth Electric Co., of 606 Arch street, Philadelphia. As will be seen it is of the Kapp type with oval fields, self-oiling bearings and sliding bed. One peculiar feature of this machine is the construction of the armature, which is wound on a wooden core, each layer being perfectly insulated. The generators are made in sizes of from $\frac{1}{8}$ to 100 kilowatts, and the motors from $\frac{1}{4}$ to 50 h. p. The speed of the arc motor is only 1,000 revolutions per minute, while that of the incandescent is but 1,200 for motors up to three h. p.


COMMONWEALTH ELECTRIC CO. PHILADA. PA.

COMMONWEALTH DYNAMO.

Mr. Charles Bockmeyer, the manager of the company, has had several years' experience in the manufacture of electrical apparatus, and has equipped the shops with machinery of the most approved pattern. His men also are skilled workers, and nothing has been left undone to make the dynamos and motors equal in every respect to the best.

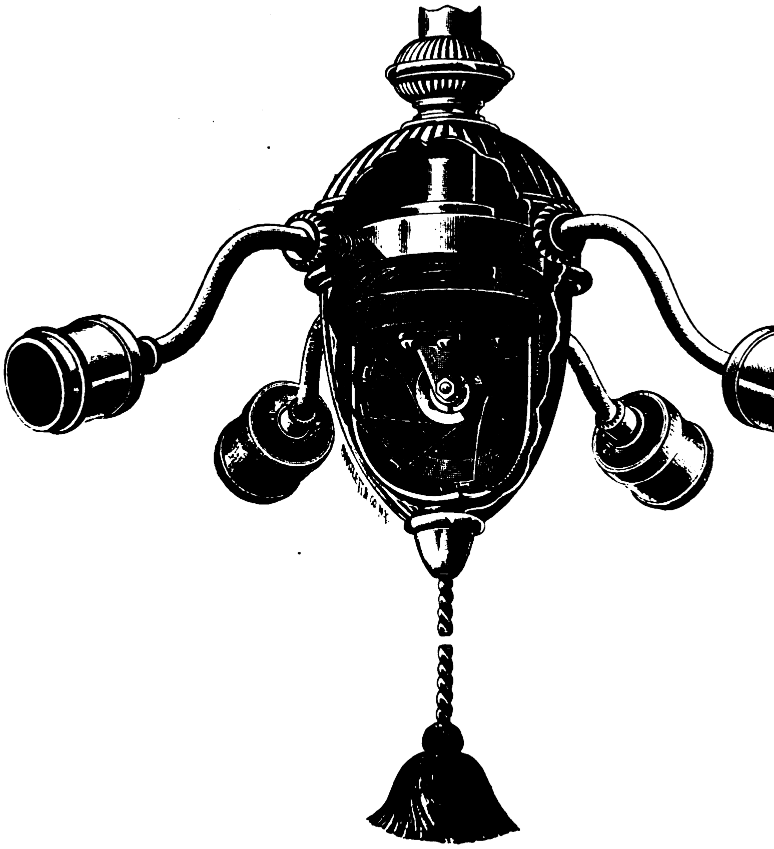
THE QUEEN RESISTANCE TESTING SETS.

Queen & Co., Philadelphia, are having a great "run" on their standard portable testing sets, as the distinctive merits of these goods make them very popular. In every central station, no matter how small, it is real economy to have accurate apparatus for measuring resistance of lines, dynamos, lamps, etc., and the Queen set "1891" type with its wide range, accurate adjustment, and dead beat galvanometer proves wonderfully efficient. Although introduced less than one year ago it is to be found all over the country, and indications point to a steady and increasing demand.

A few years back a commercial resistance set, correct within one or two per cent. was considered very "close," but such finds little sale now in comparison with the improved forms made by Queen & Co., who guarantee them absolutely to ⅛ of one per cent. Electrical engineers as well as central station superintendents will do well to examine these sets before ordering such apparatus. They are fully described in circular No. 285, which can be had by writing to the makers.

THE INTERIOR CONDUIT CO.'S CHANDELIER SWITCH.

The accompanying illustration represents the new combination chandelier switch manufactured by the Interior Conduit and Insulation Company, of New York. As many lights as may be required can be controlled by the device, which embodies the same principles as are contained in the Greenfield pull-down switches manufactured by the same company, and recently described and illustrated in The Electrical Engineer. The mechanical arrangements of this new switch are most ingenious, and are contained in the shell or body of the chandelier. A pull on the cord turns on or off at will one or more lights consecutively, thus dispensing with switches on the wall or key sockets in the chandelier. No extra wiring for the switch and chandelier is required, each light is under direct control by simply pulling the cord, and the switch can be incorporated in the body of any chandelier, as it merely intersects the stem. This ingenious and useful article is said to have attracted instant and favorable notice.



Interior Conduit Co.'s Chandelier Switch.

Mr. Robert Mackie, formerly of the Fort Wayne and Secret Service Electric companies, and lately practicing as an electrical engineer in Cincinnati, has now been appointed city electrician of that place. He has entered upon his new duties.

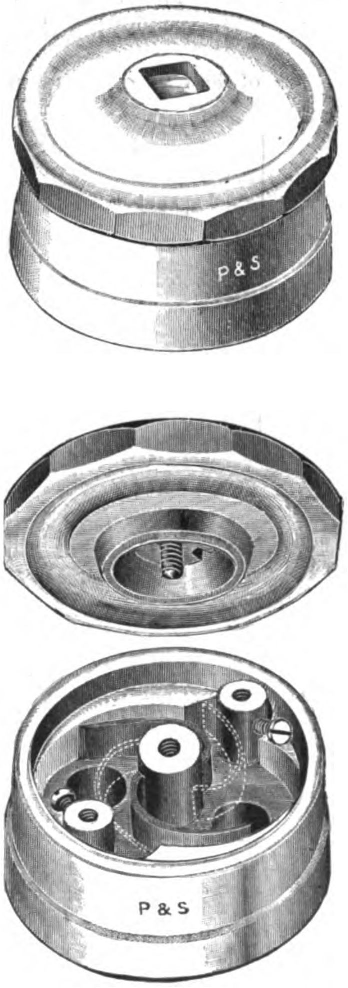
McGUIRE MANUFACTURING CO.

Mr. J. A. Hanna, who for the past eight years has been with the J. G. Brill Car Co. has accepted a position with the McGuire Manufacturing Co., of Chicago, as general traveling salesman. He will hereafter represent on the road their specialties in railway equipment. The McGuire Co. have recently closed large contracts with the South Chicago City Railway Co., Kankakee Electric Railway Co., Toledo, O., Consolidated Street Street Railway Co., and the Pueblo City, Col., Railway Co.

NEW PASS & SEYMOUR WALL SWITCH.

The accompanying illustrations, Figs. 1 and 2, show an exceedingly neat and simple form of switch recently introduced by Messrs. Pass & Seymour, of Syracuse, N. Y. It is made entirely of Syracuse china, the only metal parts being the binding posts, shaft and contact spring, and is operated by turning the cap instead of employing a key. It has a quick, double make-and-break, with rubbing contacts, the break being exceptionally long.

This switch is made for 5 or 10 amperes, and is furnished either plain or decorated in a variety of styles. Its simplicity renders any further description unnecessary.



New Pass & Seymour Wall Switch.

BALL ENGINE CO.

The North Hudson County Railroad Co., Hoboken, N. J., in March, purchased a 300 h. p. latest improved Ball engine from the Ball Engine Co., Erie, Pa. They have been so well satisfied with the performance of the engine that they have ordered an additional engine of the same power from the same company. The Englewood, Ill., Electric Light Co., Englewood, Ill., have ordered a 500 h. p. latest improved Ball cross-compound engine through the Chicago office of the Ball Engine Co. The Port Huron Electric Railway Co., Port Huron, Mich., have awarded an order for one of their latest improved engines to the Ball Engine Co. The engine is a 400 h. p. cross-compound of the latest type.

A PERRET PRINTING PRESS PLANT.

THERE has recently been installed in the press-room of the Brooklyn *Citizen* a system of power transmission of unusual interest to engineers, mechanical as well as electrical. The room contains two Hoe presses, a wetting machine, and several small jobbing presses, etc. These have all been taking power from a single line shaft extending the entire length of the room, except the wetting machine, which was belted to a countershaft, and run as usual by an engine.

When it was decided to change the power from steam to electricity, Mr. Paul T. Kenny, sole agent on Long Island for the Perret dynamos and motors, took the matter in charge and carried it through under his personal supervision. The arrangement adopted is shown in the accompanying diagram.

The line shaft was cut at a point between the two Hoe presses and again between the second one and the jobbing presses, and the sections were connected by clutches. The presses are belted to these shafts and are run by independent motors fastened overhead between the arches that support the ceiling. Each Hoe press has a 15 h. p. motor, and the group of jobbing presses, etc., has a 7 h. p., while the wetting machine is operated by one of 10 h. p. placed overhead like the others and belted to its countershaft.

The flexibility of the whole system is perhaps its most noticeable point. In case of accident to any motor, it may be thrown out and the machine to which it belongs may be run by any or all of the others, by means of the clutches. Thus there is no possibility of a general break-down, even under the most adverse circumstances, and, as an extra precaution, there is a double service from the Edison mains on two different streets, either of which can be thrown on at a moment's notice.

As the entire steam plant of the building has been abandoned, the steam table is now supplied with live steam from the central station of the Edison Electric Illuminating Co., of Brooklyn, while the building is heated by exhaust steam from the same source.

It is claimed that the total expense saved by all these improvements is at least 50 per cent., and as the slow speed of the Perret motor makes it particularly adaptable to this class of work, we expect to hear shortly of other journals coming into line and following the good example set by the *Citizen*. It will be remembered that at the beginning of the year we illustrated the Perret plant of the New York *Commercial Advertiser*.

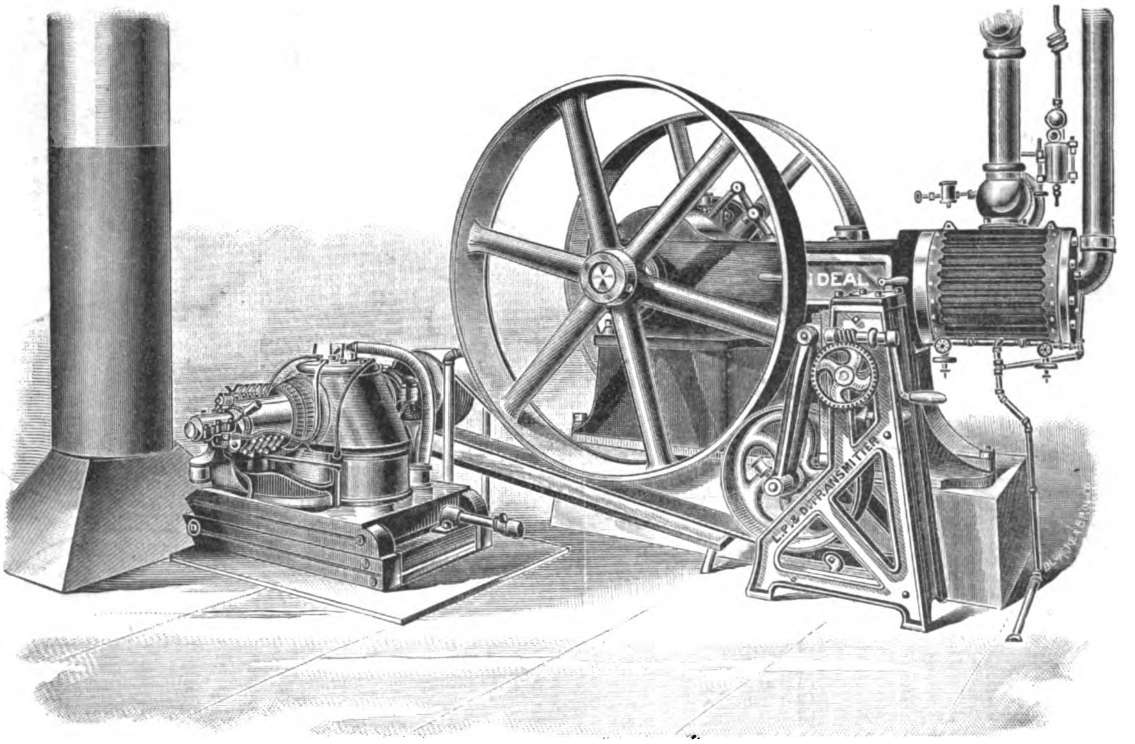
GETTING READY FOR THE ELECTRIC LIGHT.

ONE of the most beautiful parts of the newer New York is the west side from Fifty-ninth street to One Hundred and Twenty-fifth, and it is rapidly filling up with fine residences and handsome apartment houses and hotels. It is still without any central station, but the fact is recognized by foresighted owners of property there that the want will very soon be supplied. An instance of this appreciation of electricity and desire to enjoy its benefits has just been afforded by Dr. A. L. Root, a leading and well-known west side physician, who is building a costly house on West Eighty-first street. Although the electric street mains are still two miles away, he has had the building tubed and wired, for about 120 lights, and hence as soon as the current is available can switch it on without disturbing walls or decorations. He has also made ingenious provision for the use of electric light and power not only as part of the domestic economy, but as a special feature of convenience and assistance in the consultation-rooms. The work has been carried out by H. Ward Leonard & Co. who have used the Interior Conduit system throughout. It is to be hoped that many other residents in the locality will follow the excellent example thus set them, and get ready to enjoy modern methods of illumination, ventilation, etc.

"L. P. & D." POWER TRANSMISSION.

THE accompanying illustration shows an "L. P. & D." transmitter installed by Messrs. Perry & Demeritt, of Montpelier, Vt., in the establishment of Messrs. Siegel & Cooper in Chicago, where the space in which the engine and dynamo had to be placed was so small that the ordinary method of belting was impossible.

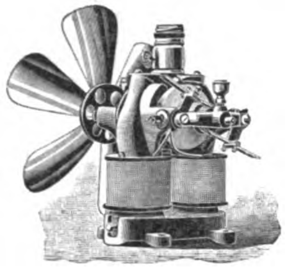
The dynamo is a 400-light incandescent Western Electric, driven by an Ideal high-speed engine with a 72-inch driver. The belt is a light double, 19 feet long by 8 inches wide. The space between the dynamo and engine pulley is 6 inches. The whole space occupied by dynamo, engine and transmitter is 8 x 11 feet. This has been in operation since April 29, 1892, and has given perfect satisfaction.



"L. P. & D." POWER TRANSMISSION AT CHICAGO.

THOMSON-HOUSTON CONTRACTS.—Among the recent installations reported by the Philadelphia office of the Thomson-Houston Electric Co. are the following: Pennsylvania R. R. Co., Pittsburgh, Pa., 100 arc; Carlisle Gas & Water Co., Carlisle, Pa., 50 arc; Norristown Electric Co., Norristown, Pa., 50 arc; Carnegie, Phipps & Co. Pittsburgh, Pa., 300 arc; West End Electric Co., Philadelphia, Pa., 1,300 inc.; Northern Electric Co.. Philadelphia, Pa., 1,000 inc.; Akron Electric Co., Akron, Ohio, 4,000 inc.; Dennison Electric Co., Dennison, Ohio, 2,000 inc.; Duquesne Electric Co., Duquesne, Pa., 1,500 inc.; Wilmington Electric Co., Wilmington, Del., 3,000 inc.; Wyoming Traction Co., Wilkesbarre, Pa., 10 cars; Easton Street Railway Co., Easton, Pa., 12 cars; East Harrisburg Street Railway Co., Harrisburg, Pa., 2 cars; York Electric Street Railway Co., York, Pa., 9 cars; East Harrisburg Street Railway Co., Harrisburg, Pa., 400 h. p. generators; Camden Horse Railway Co., Camden, N. J., 100 h. p. generators; North Hudson Railway Co., Hoboken, N. J., 16 cars; Neversink Mountain Railway, Reading, Pa., 2 cars; Rochester Street Railway, Rochester, Pa., 6 cars; Baltimore & Ohio R. R. Co., Baltimore, Md., three 1,200 h. p. electric locomotives.

THE SIMPSON NOISELESS MOTOR.

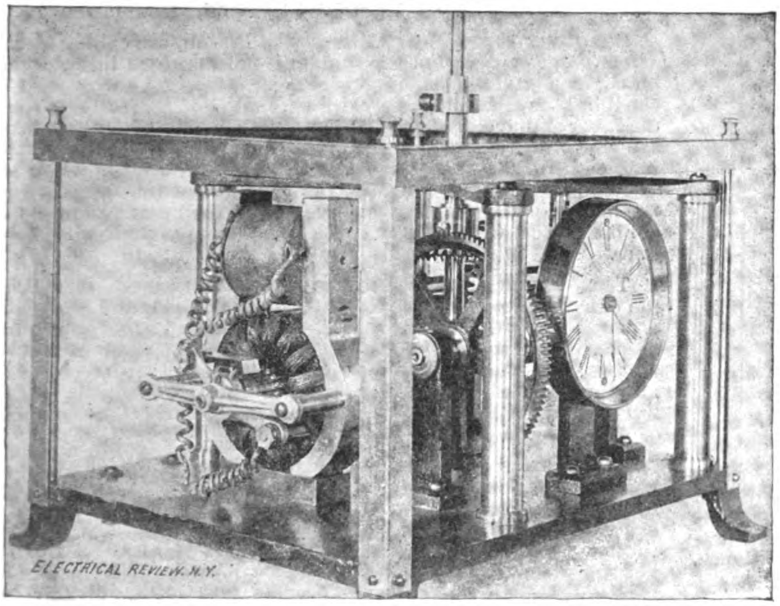


Simpson Noiseless Motor.

ONE of the latest candidates in the motor market is the Simpson Electric Mfg. Co., of 41 West Washington street, Chicago. This company is placing on the market a motor claimed to be second to none. It is noiseless, perfectly automatic and runs without any perceptible sparking whatever. Motors are furnished for arc, incandescent or storage battery circuits as desired, as well as for any voltage. The smallest of these motors receives every attention to ensure perfect construction; all boxes are babbitted, and fitted with automatic feed oil cups. The commutator is made of a fine grade of phosphor bronze and it is much larger than is generally used in small motors. In fact this machine is one that commends itself to intending purchasers. The prices are very reasonable, and the facilities of the company allow of prompt filling of all orders. The cut here shown gives a good idea of one of their fan outfits, which is very complete, and makes a veritable whirlwind.

NEW TOWER CLOCK OF THE STANDARD ELECTRIC TIME CO.

THE new electric tower clock of the Standard Electric Time Co., of New Haven, Conn., which has recently been put on the market by that company, is quite a departure from the usual means of operating tower clocks. It is operated by an electric motor with suitable gearing, so arranged as to be controlled by a self-winding regulator which starts the motor in operation once every minute. After the motor has carried the hands just one minute, it breaks the circuit automatically, allowing the hands to rest at this point until the next minute is completed, when the same thing is repeated. The arrangement of the mechanism is so positive that there is no possibility of a variation from the correct time given by the master clock.



NEW TOWER CLOCK OF THE STANDARD ELECTRIC TIME CO.

The ordinary tower clock is operated by weights, and the movement being exposed to the extremes of temperature it cannot possibly keep such good time as a clock that is finely adjusted and placed in a room where the temperature is more uniform. Besides, the ordinary tower clock must be wound up every week, which requires the full strength of one man, while the electric tower clock never requires winding.

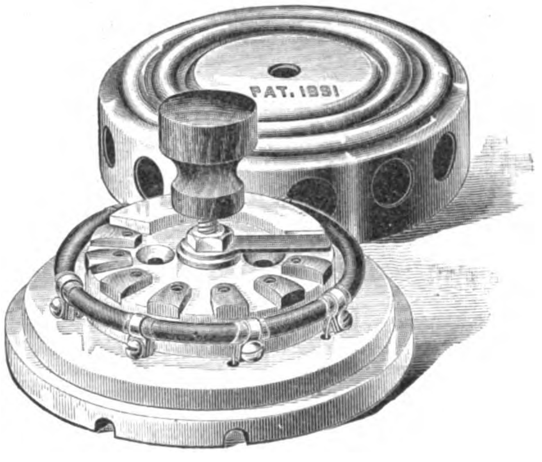
One of the very important features about this clock is the operation of the motor by open circuit batteries. It has required a great many experiments by the Time Company to arrange a motor in such a way that the battery would stand the work, and it is sufficient to say that from ten to fifteen cells of open circuit battery will drive the motor moving the hands to this clock for at least one year without any attention whatever. It will deliver more power to the hands than the ordinary tower clock will with its heavy weights.

This company has just shipped one of these tower clocks to Newport News, Va., where it is to be placed in the new depot of the Chesapeake & Ohio Railway Company. Dials will also be placed in the waiting-rooms, so that uniform time will be given throughout the building. One of these tower clocks has been in operation during the past winter and was not interrupted by any of the storms, while other tower clocks were motionless.

THE McCREARY RHEOSTAT SWITCH.

THE demand which has long existed for a means by which incandescent lamps could be turned down in the same manner as a gas jet is so obvious that a simple device to accomplish this purpose must evidently meet with a wide application. One of the neatest and most compact arrangements of this kind is that just brought out by the McCreary Electrical Specialty Co., of 136 Liberty street, this city. The rheostat switch, as it is called, is shown in the accompanying engraving, and, as will be seen, consists of a series of contacts over which passes the tongue of the switch, the carbon resistance being in the shape of a ring. By changing the switch contact the lamp can be brought from full brilliancy down to total extinction, the last contact breaking the current. The device is thus a combined rheostat and switch.

The McCreary Co. assert that by the use of this switch, and the manner by which it permits the current being turned on, the filaments are spared the shock due to the sudden turning on of full current, as usually effected, and that blackening is thereby also largely prevented. The switches are also adapted for regulating the speed of fan motors. A full line of sizes up to sixteen lights will soon be ready for the market, the rheostat switches for single 16 c. p. lamps for any voltage up to 115 volts being now ready.



McCREARY RHEOSTAT SWITCH.

THE OSHKOSH ELECTRIC LIGHT & POWER CO. have just placed their order with the Rice Machinery Company, 63 and 65 South Canal street, Chicago, for the entire outfit of shafting, floor stands, friction clutch pulleys, etc., to be used in their plant now in process of construction at Oshkosh, Wis. This plant when completed will be one of the largest generating stations in the country, and thoroughly representative in every way. The Rice Machinery Company are general Western agents for the Dodge Manufacturing Co., of Mishawaka, Ind., and the appliances are to be of the latter company's manufacture. The Dodge patent split disc clutches, and wood split pulleys will be used throughout. The main shafting is six inches in diameter, and is to be supported on the Dodge improved adjustable floor stands, and bearings to be of the late improved chain-oiling pattern. The main receiving pulleys from the engines are the Dodge Manufacturing Co.'s celebrated wood split pulleys, of sufficient capacity to transmit 500 h. p. each. The Rice Machinery Company, the contractors of the above plant, are making a special effort in the electrical field, and have installed some important plants, among them the Bessemer Electric Co., at Bessemer, Ala., 400 h. p. plant, and the plant at the Grant Locomotive Works, near Chicago, furnishing the motive power for their 30-ton electric cranes.

ONE ORDER.

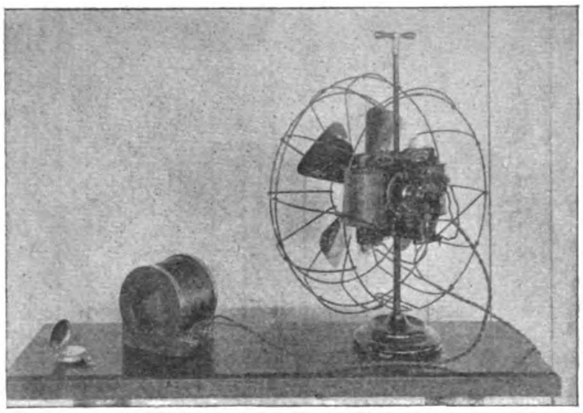
ONE order of three hundred (300) miles of aerial cable! The Day Kerite Wire Company have just secured this prize from the New York Central and Hudson River Railroad. This cable is an eight conductor, and is to be used in the most complete block signaling system ever installed. This cable will be stretched between New York and Buffalo, and will be, when finished, the longest stretch of one cable ever sold by any company in this country.

NEW YORK AGAIN WEDDED TO NEW JERSEY BY KERITE.

ON Saturday, July 16, the Kerite 18 conductor armored submarine cable, recently completed for and accepted by the Metropolitan T. & T. Co., was successfully laid. Its length, from landing to landing is 5,300 feet. Another cable, similar in every particular, is about completed, and will be put in use in about two weeks.

THE "ELECTRO-DYNAMIC" WATCH DEMAGNETIZER.

WE illustrate on this page the new watch demagnetizer brought out by the Electro-Dynamic Co., 224 Chestnut street, Philadelphia. It consists substantially, as shown, of one of the standard Electro-Dynamic one-sixteenth h. p. fan motors and an induction coil. A device is connected to an extension of the commutator nut inside the bearing-stand, so constructed as to admit of its introduction by being curved inward. By means of brushes an alternating current is taken off the device and carried to the coil by a flexible cord. Jewelers and watchmakers generally will find the device a useful adjunct to their equipment, and it should be brought to their notice by local companies, etc. The Electro-Dynamic Co. are placing the device on the market at a low figure, and are furnishing outfits of the entire combination.



THE "ELECTRO-DYNAMIC" WATCH DEMAGNETIZER.

WESTERN NOTES.

ELECTRIC APPLIANCE CO.—The severe and unusually heavy electrical storms of the past two months have proven very disastrous to electrical machinery in a number of instances. They have also served to show the effectiveness or otherwise of the many devices on the market designed to protect electrical machinery. The Electric Appliance Company are getting considerable satisfaction out of the many unsolicited testimonials they have received in regard to the "Swinging Ball" lightning arrester. They have equipped a large number of plants in the West with this device, and have received nothing but the most flattering testimonials from every customer, substantiating every claim that has ever been made for the Swinging Ball lightning arrester.

THE CENTRAL ELECTRIC COMPANY have just gotten in a consignment of Lundell fan motors, and they are making a breeze, which is needed at this particular time of the year. They report the sales of Okonite for the past week as almost equal to the sales of the preceding week, which was the largest in the history of the company. The Central Electric Company also report a very lively demand for arc light carbons. The Washington carbon, for which they are the general Western agents, are giving general satisfaction.

MR. GUSTAVE MONRATH, who has been installing the new plants at Marseilles, Ill., is now back at Chicago, where he will put the Armstrong elevator signals into many of the new skyscrapers.

IMPROVES WITH HARD USAGE.—F. W. Cushing, general Western agent for Day's Kerite wires and cables, has just received from a local lighting company a section of marine cable that has been in use for over four years carrying all this time both night and day a pressure of 2,400 volts without a leak ever having been detected. This cable seems to have actually improved, and looks as perfect as a new piece. Kerite insulation is the reason for this no doubt.

LIGHTNING ARRESTERS.—Referring to the great amount of trouble experienced this season on electric roads from lightning, the Railway Equipment Co., Chicago, state that they are about ready to place on the market a lightning arrester of unusual merit for station, car and line use. Parties who have had trouble during this season from any cause should write them for full information, which will be cheerfully given on application.

MR. G. M. ANGIER, general agent of the Mather Electric Company, has just returned from a business trip South and West. Mr. Angier has established a number of agencies and reports the outlook for business good especially in power transmission and isolated lighting plants of which the Mather Electric Company make a specialty.

MR. J. B. WOOD, who for the past two years has occupied a prominent position with one of the large Chicago supply companies, has resigned and accepted a position with the Knapp Electrical Works. He is receiving the congratulations of his many electrical friends.

MR. CHAS. M. HOWELL, Bessemer, Mich., president of the Illinois Electric Lamp Co., spent some time in Chicago, recently, looking after his interests in the above corporation.

NEW ENGLAND NOTES.

SHAWMUT FUSE WIRE COMPANY, of Boston, are calling special attention at present to their standard railway fuse links, which have given great satisfaction wherever used. The wire used in these links is most accurately drawn, and is of perfectly uniform diameter and composition. The varying conditions of fuse wire are all carefully taken care of by calculation, and always supplemented by testing. The value of this is easily appreciated when it is known that wire will fuse at a very different ampereage, when the length of the wire varies; thus, a wire fusing at 60 amperes in a 5-inch piece, would carry twice the current in a piece 1¼ inch long.

THE WESTINGHOUSE ELECTRIC COMPANY, through their Boston office, have contracted with the Wakefield and Stoneham Street Railway Company, of Wakefield, Mass., for four car equipments, consisting of two 20 h. p. Westinghouse single-reduction motors for each car. The road will be in operation by August 1, and the roadbed is now in process of construction and will be finished in about a week. The Clemmons Construction Company, of Attleboro, Mass., will do the construction work.

MR. ARTHUR J. ARNOT, electrical engineer to the city of Melbourne, Australia, is sojourning in this city for a few weeks, having come over, amongst other business, to witness the tests of a large number of Thomson-Houston dynamos which are intended for use in lighting the city of Melbourne. Mr. Arnot intends visiting Chicago and other cities, and will return to Australia by way of England, where he will spend a few weeks. Mr. Arnot's present address is the Parker House, Boston.

MR. GEORGE CUTTER, of Chicago, is once more amongst his many friends in Boston, and is feeling in excellent spirits over some peculiarly happy business deals which he has just made. Among others he has just secured the Western agency for the new Enamel Resistance, which he expects to become a most important product in a very short time. This resistance is composed of zigzag wire embedded in enamel, so that it is virtually water and fire proof.

THE ENGINEERING EQUIPMENT COMPANY, 143 Liberty street, New York, has secured, by papers just executed, United States rights of manufacture and sale of the Goodell boiler and pipe covering. This is an important addition to the company's business, which is now divided into three special departments, viz.: Belting, boiler and pipe coverings, overhead electric railway materials. In each of these specialties the company purposes to enlarge its facilities and strengthen its position in the trade from time to time.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XIV. JULY 27, 1892. No. 221.

ELECTRIC SEARCH LIGHTS.[1]—I.

BY

E. R. Knowles. C. E.

WHAT is an electric projector or search light? In simple terms it is an apparatus by means of which a powerful beam of light from an electrical source may be projected or thrown forward to illuminate distant objects. From time immemorial man has endeavored, with more or less success, to communicate intelligence of impending danger, warning of the approach of enemies and instruction as to the avoidance of such danger and the repulsion of the enemy, or news of success, of victory, of peace, or other information of importance to his fellow-men, when separated from them by distances too great for the ordinary means of intercourse. The rudest savages practice such inter-communications either by means of bonfires, smoke, drums, or sounds of various kinds, and more civilized communities have and do now make use of such means as semaphores or moving arms, waving or flashing lights, rockets, whistles, bells, guns, balloons and flags for similar purposes; signaling by means of flags of different designs and colors being one of the simplest and most largely used means which is employed where the persons communicating are within sight of one another.

In more modern times, as the messages to be communicated have increased in number and variety, and the places to which such messages have to be sent have become farther apart and more inaccessible, other and better means of communication have been devised from time to time to successfully convey such intelligence easily and rapidly, and finally electricity has been harnessed into service so that at the present time it is the most widely used means of conveying intelligence rapidly between points or persons separated by vast distances where all other means of quickly communicating intelligence fail. Signaling by electricity may be accomplished in various ways, principally by means of the telegraph and telephone, and at night the electric light is used for all distances at which it is visible. Under this latter head may be classed the subject of this lecture.

The electric projector or search light is simply an enormously powerful electric lamp, so arranged that its light may be visible at a considerable distance, when by intermitting its light according to some preconcerted code of signals or flashes any desired message may be conveyed from one point to another. While the electric projector serves its purpose admirably as a means of communicating intelligence to a distance, it has also another and quite as useful application, that of protection at night; for by its means large areas of land or water can be illuminated, the approach of an enemy discovered, aid rendered in time of accident or shipwreck, and the path of the ship over the wastes of the ocean illuminated and rendered safe from danger and disaster. Its various uses are beginning to be more and mode widely appreciated, and its applications in its manifold and varied forms are rapidly and increasingly being found out and put to practical use.

The earliest use of the electric projector or search light is said to have been during the Crimean war, when it was operated by a galvanic battery. That may be considered the ancestral type of the modern mechanism. In 1867 a projector was placed on board the Emperor Napoleon's yacht, the "Reine Hortense," and in 1870 similar ones were installed on the cruisers "Forbin" and "Distree," a magneto-electric machine, the "Alliance," being used as the source of electric energy. In 1873 and 1874 the Russians had the iron-clad "Peter the Great" and the Imperial yacht the "Livadia" fitted with electric projectors, the source of eletric energy being the then newly-invented Gramme dynamo. In 1877 the French made use of such projectors on the iron-clads "Richelieu" and "Suffren,"

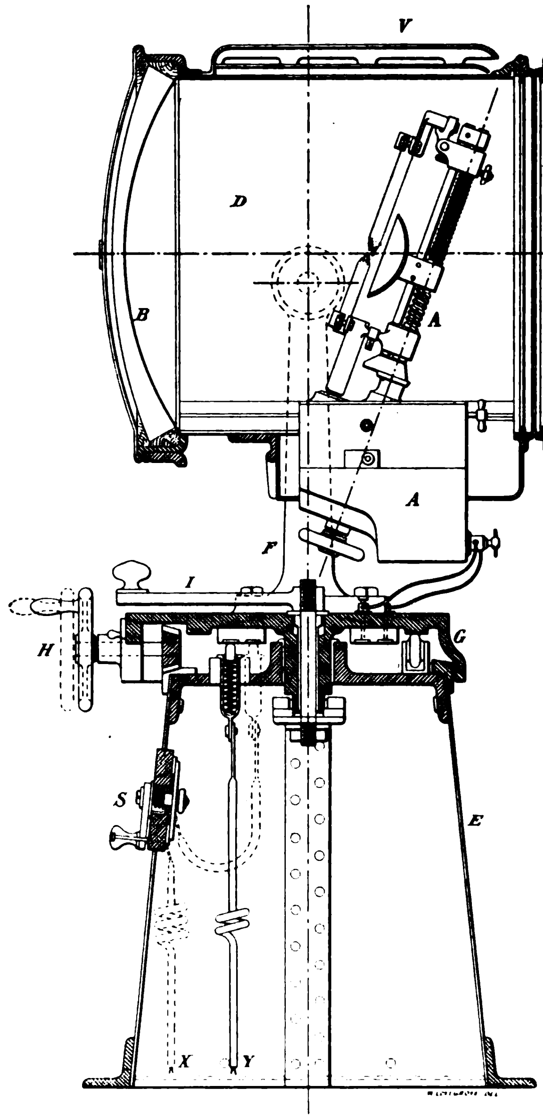


Fig. 1.—A Modern Electric Search Light.

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[1] Based upon a lecture delivered at Middletown, Conn.

which were also operated by Gramme dynamos. Great improvements now began to be made in projectors, resulting in their use becoming more and more extended, and finally in their becoming part of the regular equipment of our own and foreign men-of-war. In 1887 the use of projectors was begun on the Suez Canal, and has greatly increased its capacity for traffic, vessels provided with the apparatus being allowed to make the passage at night, the receipts of the canal company, by these means, being nearly doubled. The electric projector is also coming into general use in the army, in fortifications and coast defense, and for a great variety of commercial and other purposes; for example, they were used by the Italian expedition to Massowa; also during the recent French Exposition with great success in lighting the Eiffel Tower, and quite recently in Gibraltar Bay when the emigrant ship "Utopia" was lost, at which time the loss of life would undoubtedly have been far greater but for the fact that all the vessels of the British squadron which were provided with electric projectors promptly concentrated their powerful beams of light upon the place where the unfortunate vessel sank, illuminating the spot as by daylight and enabling the rescuers to save the drowning unfortunates who were struggling in the waters. The time is not far distant when every steam vessel of any size and every locomotive will carry some form of this apparatus as a regular part of its equipment, when every fortification will use them as a means of offense or defense, when all important buildings and localities will be furnished with them, and when every lighthouse will use their far-searching beams to warn the mariner of danger or direct him to a haven of safety.

In its simplest form the electric projector consists of an electrical source of light, a mirror or lens for concentrating and reflecting the light and mechanism by means of which the resulting beam of light may be directed to any desired point. A type of such a projector is shown in the illustration, Fig. 1, which represents a vertical cross-section of one of these instruments, so that all its various parts can easily be seen, A being the electric lamp, B the reflecting lens-mirror and C, D, E, F, etc., the various parts of the mechanism for controlling and directing the light. I shall refer to the essential parts of the electric projector in the order stated, and first will describe the electrical source of light.

The voltaic arc is formed between the ends of hard carbon rods or pencils connected to the ends of the conducting wires. The free ends of these carbons are first brought into contact either by hand or by suitable mechanism, and then separated. The heat generated at this point of separation between the carbon rods is so great (about 7,000 F.) that a portion of the carbon is volatilized and acts as a conductor between the separated ends of the carbon rods, and it and the tips of the carbons become white hot and emit a dazzling light. The light so generated is called the electric arc light, and is of all known artificial sources of illumination the most intense.

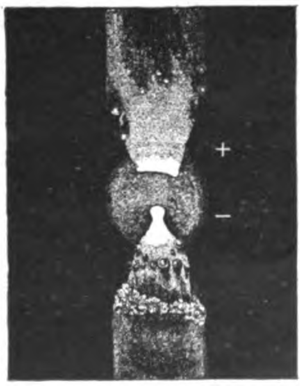


FIG. 2.

Under the action of the electric current the carbons are slowly consumed and assume the appearance shown in the illustration, Fig. 2. If the carbons rods are of the same diameter, one of them, the positive carbon, consumes about twice as fast as the other or negative carbon, and if the electric arc is to be maintained, means must be furnished for gradually bringing the carbons together as they are consumed, so that the distance between their points may remain constant in length and so prevent the extinction of the light. This may be accomplished by pushing the carbons together by hand, in a lamp such as is shown in the illustration, Fig. 3, a rather troublesome and inefficient way of so doing; or, as is the modern practice, they may be so arranged in suitable mechanism, that as they consume and the distance between their ends increases, they will be automatically brought together by the varying action of the electric current which forms the voltaic arc.

It is a well-known law of electric action that the amount of current which will, under a given pressure or difference of potential energy, flow through a given current is inversely proportional to the resistance of that circuit; that is to say, the greater the opposition which the circuit offers to the passage of the current or the greater its resistance the less the amount of current which will flow through it; also, when an electric current is divided, offering more than one path for the passage of the current, that the current will divide itself through all the paths offered and inversely proportional to the resistance of each path. Advantage is taken of these facts in designing a mechanism to automatically separate the carbons and so form the voltaic arc and to bring the carbons together as they consume.

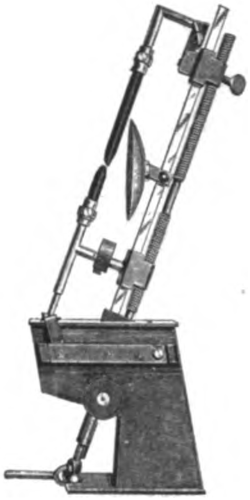


FIG. 3.

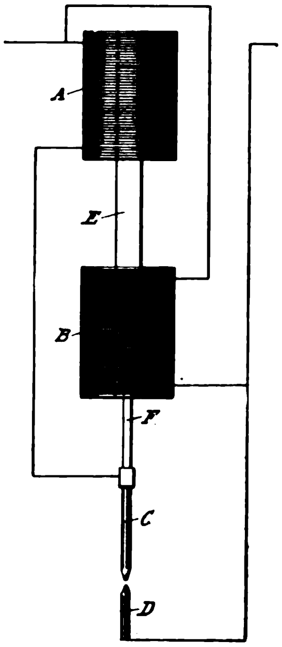


FIG. 3 A.

In its simplest form a mechanism, known as the electric arc lamp, may be represented by the diagram, Fig. 3 A. A is a sucking magnet wound with coarse wire and of low resistance and is connected between the + point of the circuit and the carbon rod C. B is a sucking magnet wound with fine wire and of high resistance and is connected between the + point of the circuit and the — point of the circuit. E is an iron core passing loosely through the magnets A and B and carrying at its lower end by means of the rod F the carbon C. The other carbon is represented by D and is connected to the — point of the circuit. It will be seen that there are two paths offered for the passage of the current, one from the + point of the circuit through magnet A carbons C and D to the — point of the circuit, and the other from the + point of the circuit through magnet B to the — point of the circuit. The first one of these paths is through the carbons and is of low resistance, offering but feeble opposition to the passage of the current, while the second path is around the carbons and is of high resistance, offering considerable opposition to the passage of the current. When there is no current flowing through the lamp the carbons are together, but when the current is applied to the lamp it divides, the major portion going through magnet A and the carbons C and D and the minor portion going through the magnet B. The magnets A and B are so wound and connected that they tend to attract or suck in the iron core E in opposite directions. Now when the current is first applied magnet A is strongly energized and magnet B is feebly energized so that magnet A attracts and sucks in core E against the opposing pull of magnet B, thus drawing the carbon rods apart and striking the voltaic arc between their ends. As the ends of the carbon rods burn away and the distance between them becomes greater, the resistance of the first path for the current increases, due to the increased resistance offered by the increasing distance between the ends of the carbons, and less current flows through it. The magnet A becomes weaker and weaker and offers less and less opposition to the pull of magnet B, which finally balances and then overcomes the pull of magnet A and sucks the core E into itself, thereby bringing the ends of the carbons C and D nearer together and shortening the distance between their points to their original distance apart, thus maintaining the voltaic arc constant in length. When the magnets A and B are just about balanced and B is gradually overcoming A and drawing core E into itself the lamp is in proper working order and the voltaic arc is maintained at a constant length. All the action depends, as stated, upon the varying resistances of the two paths offered for the passage of the current and upon the varying distribution of the current through these paths.

In the design and construction of such a mechanism for use in the electric projector, not only the peculiarities of behavior of the voltaic arc must be considered but certain other conditions which arise must also be taken into account and provision made therefor. In the first place, a mechanism must be provided which will, when the light is required to be produced, automatically bring together the tips of the two carbon pencils and then draw them apart the required distance, thus striking the arc.

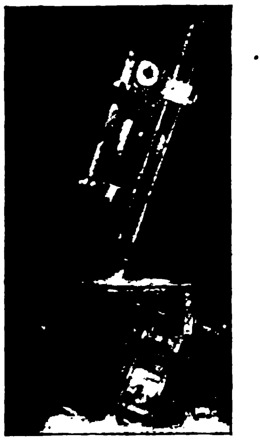


Fig. 4.

Second. As already stated, the carbons slowly consume, and the distance between their ends lengthens, and to prevent this and maintain this distance constant so that the light may not go out, there must be provided a mechanism to automatically feed one or both carbons forward in proportion to their consumption.

Third. In the event of the extinction of the arc, the striking and feeding mechanism must be so arranged as to come into operation and bring the tips of the carbons again into contact and then restrike the arc.

Fourth. As already stated the carbons consume at unequal rates, and if it is desired, as it is in all electric arc lights used in projectors, to maintain the position of the luminous arc at a fixed point, which in the case of the electric projector is at the luminous focus of the reflecting mirror as will be described further on, means must be provided for feeding each carbon forward at a rate of speed proportional to its rate of consumption. In other words, such a lamp must have a striking mechanism, a feeding mechanism and a focusing mechanism, and all of these must be automatic in their action.

The illustration, Fig. 4, shows a type of lamp of this description, such as is used in the electric projector which is being described. If when the current is applied to this lamp the carbons A and B are apart, the shunt magnets C and D operate the clutch E and by it turn the right and left screws F and G until the carbons are brought into contact, when the magnet H is brought into action and strikes the arc by drawing carbon B down and away from carbon A. If the carbons A and B are in contact when the current is applied to the lamp, magnet H draws carbon B down and away from carbon A and so strikes the arc. As the carbons consume and the arc tends to lengthen, shunt magnets C and D, by means of the clutch E, rotate the screws F and G and gradually bring the carbons nearer together, just enough to compensate for the amount of carbon burnt away, thus keeping the length of the arc constant. If the lamp is extinguished it performs the same cycle of operations as above described and relights itself. The arc is maintained at the focal point of the mirror by so proportioning the feed of the screws F and G that they each feed their respective carbons A and B together at a rate proportional to the rate at which they are consumed, thus keeping the luminous arc at a fixed point.

The electric arc lamps used in the electric projector are very powerful, giving with 75 to 100 amperes a luminous intensity of from 20,000 to 30,000 c. p.; that is to say, a light equivalent to that which could be obtained from 20,000 to 30,000 candles all burning at once at one spot, if that were possible. The carbon rods used in these lamps are from ¾ of an inch to 1¼ inches in diameter and the lamps are designed to burn continuously for about six hours. The position of the luminous source of light in the projector is at the luminous focus of the reflecting mirror as shown in the illustration, Fig. 1, and the mechanism of the projector is so arranged that the luminous source may be adjusted exactly to this point.

SENSITIVE WATER JETS.

PROF. W. B. CROFT, in a note to *Nature*, says: "A form of this effect lately presented itself which seemed in some ways new. A thin jet, 5 feet high and arched so as to be 3 feet at the base, was falling in a feathery spray. At 13 feet distance a small Wimshurst machine was set going; not instantly, but after two minutes, the spray gathered itself up almost into one clear line; although the jet was turned up and down and the machine was discharged, the falling water would not resolve itself again into spray for fifteen or twenty minutes. It is difficult to imagine the medium for this action; it is too indefinite, perhaps, to suppose that an indicator is found for the trembling of a disturbed ether while it is dying down. The well-known experiment is not known enough, for it is not often described in books. Take a glass rod, electrified ever so little, to a certain point; at once the jet collects itself; a slight move away brings back the old disorder, while an inch nearer makes things much worse. It is a striking illustration to help one to imagine what the electrical forces of the air may do.

MAGNETIC AND ELECTRICAL PHENOMENA OF TRAINS PASSING AN OBSERVATORY.

A FRENCH journal describes an interesting phenomenon relating to two railways, one the Scaux line and the other the Ceinture, which pass within a comparatively short distance of the Montsouris Observatory, Paris, the former line being about eighty metres distant and the latter sixty. It appears that during the passage of trains on the Ceinture line, which is nearest to the observatory, the bifilar magnet is found to be disturbed, and its oscillations are registered photographically—indeed, the movements are so regular that the curve clearly indicates the exact time of each train passing the observatory. The trains on the Scaux line give rise to a phenomenon not less remarkable; that is, whenever the driver blows off steam the electrometer is partly discharged, the electrical potential of the air falling to about one-half its original value. It appears that these phenomena have been considered of sufficient importance to be brought forward by the Paris Observatory in opposition to the proposed extensions of the railway from Scaux to the Place de Medicis.

MODERN AMERICAN TELEGRAPHIC APPARATUS.—
IV.

BY

F. W. Jones

DYNAMO CURRENTS ON TELEGRAPH WIRES.

THE adoption of dynamos in place of chemical batteries for generating the currents at principal stations to supply the local circuits therein and the main circuits radiating therefrom, marks an important advance in the improvement of the telegraph.

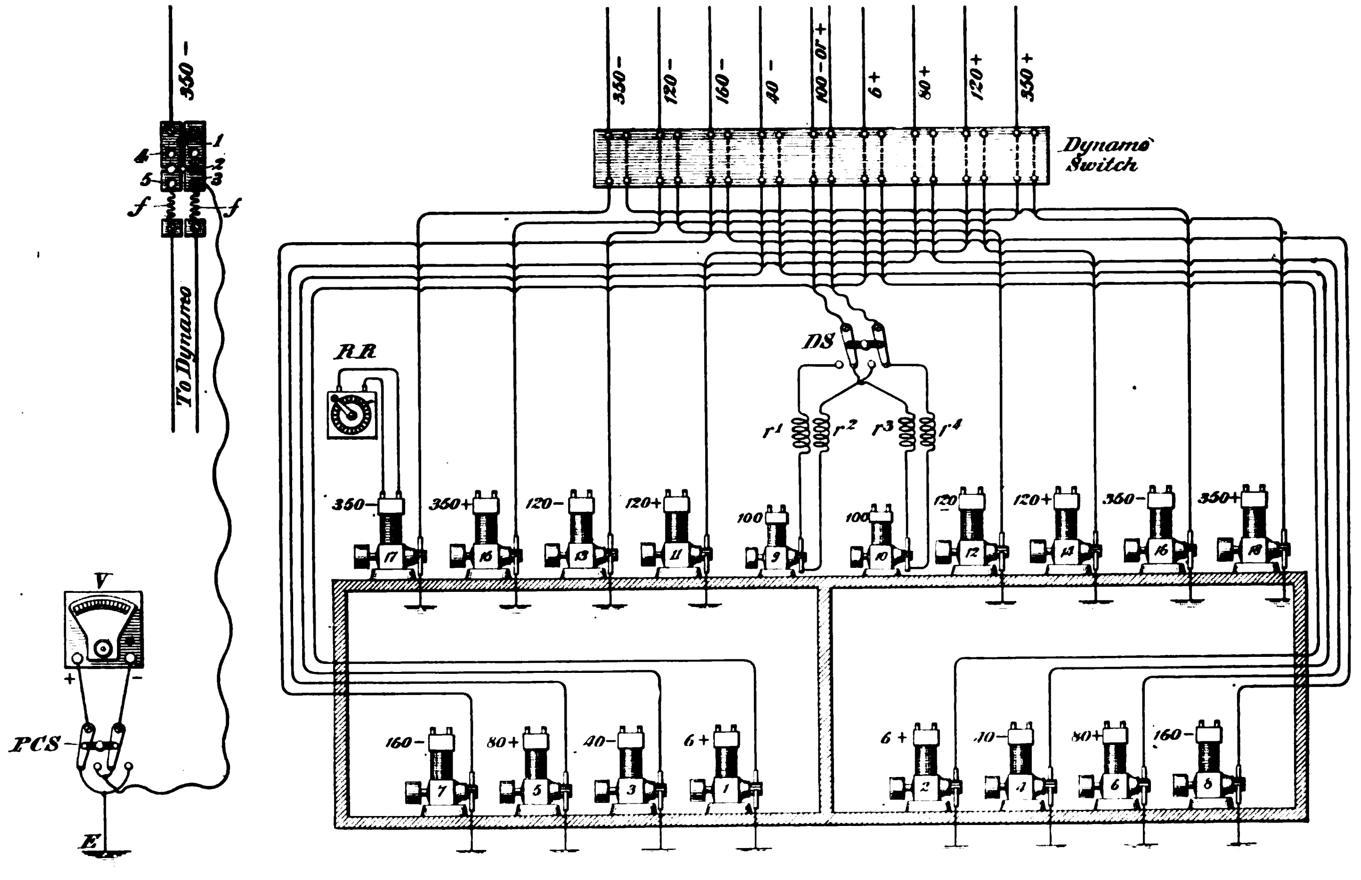


FIG. 2.—"INDEPENDENT" DYNAMO TELEGRAPH SYSTEM IN USE IN POSTAL TELEGRAPH-CABLE CO'S. SERVICE.

From the nature of things dynamos cannot well be employed in such numbers and varying gradations of E. M. F. as batteries; therefore in practice a limited number of dynamos of suitable potential and polarity is employed, and the circuits are grouped and graded to meet the new conditions, necessitating an entire rearrangement of wires and an outfit of novel switches and other apparatus.

Heretofore the Callaud batteries which have been the standard, have had from two to several ohms' internal resistance per cell and the custom has been to connect to one battery several wires (usually four). When such wires were attached to a battery having a high internal resistance, the incoming currents, obeying Ohm's law, made a portion of themselves manifest in each other's circuits. Owing to the low internal resistance of dynamos all circuits attached thereto are brought very nearly to the zero of the earth.

Besides the use of dynamos in telegraphy the adoption of wires of superior conductivity, and the improvement made in some of the electrical and mechanical features of the apparatus employed in signaling, have been the only advances of any importance within recent years towards securing a greater traffic capacity of the wires. An enormous loss of facilities has been sustained by reason of defective insulation and notwithstanding the occasional cleaning of glass in some smoky districts and the addition of petticoats to the insulators, the leakage continues to play a very serious part in restricting the earning power of all interurban circuits which in this country are exceptionally long and subject to locomotive smoke upon railroads, and the frequent contact of ornamental foliage.

There are two distinct telegraph dynamo systems in use, the "series" and the "independent"; the former has been installed by the Western Union Telegraph Co. in the cities of New York, Chicago, Pittsburgh and St. Louis; the latter system is operated by the Postal Telegraph Cable Co. in New York, Chicago, St. Louis, Boston, Philadelphia and Pittsburgh.

The "series" system has already been clearly described by Mr. Alfred S. Brown in THE ELECTRICAL ENGINEER of January 27, 1892. In this system, shown in part in Fig. 1, five dynamos, (two of seventy volts each and three of sixty

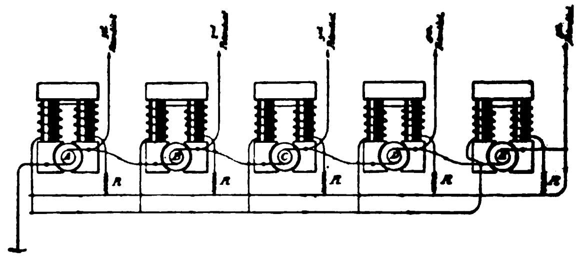
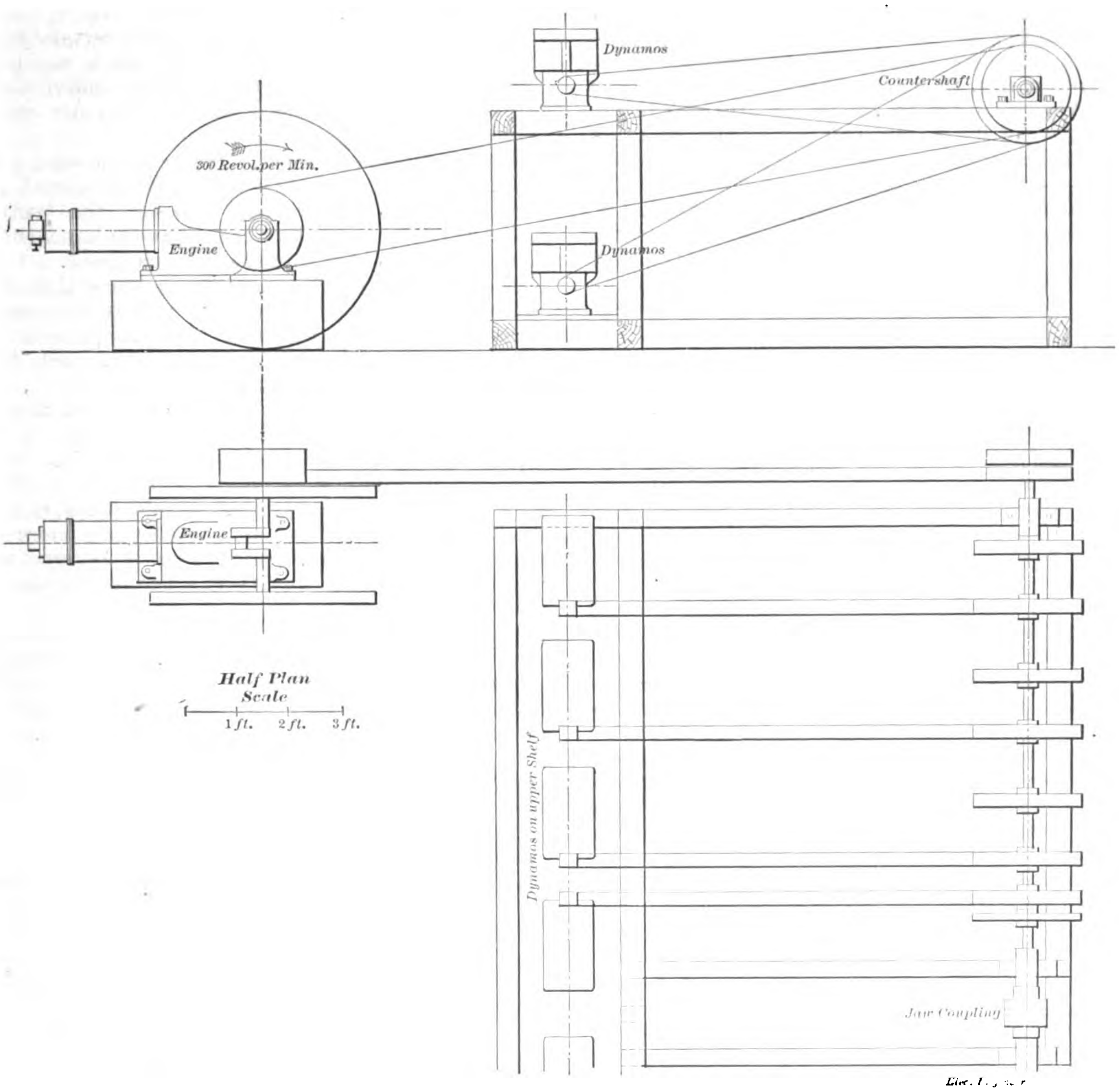


FIG. 1.—SERIES SYSTEM OF DYNAMO TELEGRAPHS.

volts each) have their armatures connected up in series with one pole of No. 1 dynamo connected to the earth, and their fields are connected in multiple and are energized by a current from No. 5 dynamo farthest from the earth at an E. M. F. of 60 volts; the machine, however, having a potential of 320 volts at its free terminal. These dynamos are rated as 2½ kilowatts each, or about 41½ amperes and sixty volts each, and in order to develop the full energy of all the dynamos in the series the whole load must be carried by No. 5 machine yielding 40 amperes at a pressure of 320 volts = 12,800 watts. The moment any current is tapped from either of the machines intermediate between No. 5 and earth, that moment the system fails to yield its normal energy. For example, suppose 8 amperes were tapped from each dynamo at their E. M. F. prevailing at the tap wires between them; then the total energy available would be only 7,920 watts, or 62 per cent. of their combined capacity. If 40 amperes were tapped from No. 1 dynamo it is obvious that the energy at 70 volts is 2,800 watts and that no further current could be supplied by the other 4 dynamos as No. 1 is capable of carrying no more than its own current of 40 amperes through its armature. So that each dynamo yielding an average of 8 amperes is only carrying one-fifth of its normal current in its armature, so far as its own output is concerned.

Fig. 2 is a conventional sketch of the independent dynamo system, particularly the one installed in Philadelphia, showing 8 Edison 1½ kilowatt dynamos and 2 Edison ¼ kilowatt dynamos on a top shelf, and 8 Edison 1½ kilowatt dynamos on a bottom shelf of a yellow pine frame which is self-contained, thoroughly braced, with grouted bed, and has no attachments by which any jarring can be communicated to the walls or floors of the building.

Fig. 3 is a half plan of the frame. There are two 7 h. p. Otto gas engines of the latest pattern, belted to driving pulleys respectively on either ends of the two shafts whose inner ends are fitted with a clutch coupling so that they may be run singly or together. At the outer ends of the shafts is a fast and loose pulley with a belt shipper. When starting the engine the belt is on the loose pulley.



FIGS. 3 AND 4.—ARRANGEMENT OF DYNAMO TELEGRAPH PLANT, POSTAL TELEGRAPH-CABLE CO., AT PHILADELPHIA.

The dynamos comprise two groups upon the frame. One group of 9, is on the left, numbered with odd numbers. Eight of these dynamos are connected one pole of each to earth, the other to the left-hand strap of each pair of straps on the dynamo switch. The right-hand group is numbered with even numbers and connected to the right hand switch straps, as shown. From the top of the switch the wires run to the switchboards in the operating-room and furnish the potentials and polarity of currents required to operate the various classes of circuits. No. 9 and No. 10 dynamos on the top shelf of the frame are 250 watts each at 100 volts and are connected to a wedge at the main switch to be used for intermediate or testing purposes the same as 100 cells of Callaud battery, the resistances r^1, r^2,

r^3, r^4 constituting an internal resistance of about three ohms to the volt to prevent sparks and short-circuiting.

Only one group of machines and one gas engine are in operation at one time, the other group being held in reserve. A section of two straps of the dynamo switch over the voltmeter V shows No. 16 dynamo 350 *minus*, of the right group, connected by plugs at 1 and 2 to the wire leading to the operating-room, No. 17 dynamo of the left group being open. The holes 4 and 5 may be used for ammeter plugs and can be inserted and a reading taken without interference by pulling out plug 2. The voltmeter connects at 3 and has a switch P C S to adapt it to dynamos of either polarity. D S is a switch by which either No. 9 or No. 10 dynamo may be put in circuit. Each machine has a regulating rheostat included in the field coils, only one of which R R is shown on No. 17 of the left group.

The dynamos are shunt-wound and are constructed for the amperes and E. M. F. they are respectively expected to yield. Belt slippage, or any accidental imperfection in the operation of either of the dynamos of a group, in no manner affects the currents of the other machines and it is seldom if ever necessary to stop the group on account of the disability of one dynamo. But one set of brushes intervenes between the line wires and the earth, whereas in the series system several sets of brushes may become the path of the line circuits to earth and any default in one machine impairs or destroys the action of every machine beyond and affects all circuits attached thereto.

Just what inductance five series dynamos add to a circuit that is attached to No. 5 machine would be interesting to know, although I do not believe it is very great. An Edison 1 K. W. dynamo 350 volts has about 4 millihenrys with a current of 6½ milliamperes and a similar 40-volt dynamo has about $\frac{1}{1000}$ millihenry. What effect the inductance of these dynamos when running with heavier currents has in adding to the time constant of a telegraph circuit attached to said dynamos, at present, is a matter of conjecture.

Excepting the 6-volt machines used exclusively for local circuits, the dynamos are not only the generators, so to speak, of the currents necessary to actuate the electromagnets in the line circuit at a distance, but they also necessarily constitute the path to earth for all incoming currents from distant stations. It is simply bewildering to try to imagine what takes place in these machines during the operation of several quadruplexed and duplexed circuits. It is to be noted that the energy of distant currents has become nearly exhausted on their arrival at the machines in question. In the "series" system a complete installation consists of three groups of five dynamos each. Two of these groups are kept in constant operation. Local circuits are supplied by other machines run independently. The two running groups have a nominal capacity of 25,000 watts. Of this energy only 14,000 watts can be utilized provided an equal amount of current is taken from each dynamo; but as in practice the lower potentials are in greater demand, it is probable that not 10,000 watts are available. The (8) dynamos forming one group of the Philadelphia plant having a joint capacity of 12,000 watts, each machine being 1½ kilowatt at its normal voltage, are capable of supplying a larger number of circuits than the two groups of 10 2½ K. W. machines arranged in series. Fig. 4 shows the arrangment in end view.

WHAT IS IT?

THE London *Financial News* states that Mr. Augustus de Missoli has applied for permission to erect a telegraph line on the Tesla system between Buenos Ayres and Rosario. The company, which has already the necessary capital is to go under the style of Electrofonia Franco-Argentina. The Department-General of Postal and Telegraphic Service has reported favorably on the proposal.

CONDENSING WITH TRIPLE-EXPANSION ENGINES.

BY

Ernst Egger

I HAVE read with great interest, in THE ELECTRICAL ENGINEER of January 20, 1892, the description of the Van Vleck triple-expansion engine, and I have studied this machine in the Twenty-sixth street station of the New York Edison Co. with care. Everybody will admit that this machine, considering that it is the first of this kind in the country, shows many superiorities, although I am sure that the subsequent engines will certainly be without some defects which are still inherent in this pattern.

I have not in mind to enter into the individualities of the design, but will confine myself to the non-condensing feature of the engine.

At the same time I must refer to the article, published by Mr. Zehme, in THE ELECTRICAL ENGINEER of April 6, which gives pretty clearly the views of the leading German engine builders. Further, I have in mind the answer which Mr. Van Vleck wrote in the same issue.

Mr. Zehme gave expression to the view that by using condensing with triple-expansion engines, one can get an increase of efficiency of from 20 to 25 per cent. I find that this affirmation is quite correct, and Mr. Van Vleck is unable to refute it. He says, merely, that the value of the condenser is not so great, but that he has no time to prove this. That is a queer way of refuting an argument which an adversary can prove at any time. There are running in Germany, Austria and France so many triple-expansion engines, all condensing, that the results obtained with these undoubtedly are more credible than mere conjectures, which one is obliged to make here, because no such engine was running in this country until recently.

It is natural that in one and the same engine the advantages, obtained with the condenser, should vary within certain limits, since they depend on the load at the time, that is, on the length of admission in the high-pressure cylinder, and Mr. Zehme adds, very truly, that, especially in small loads, condensing is not only economical of steam, but very useful for the noiseless working of the engine. That is a fact of importance in engines with long stroke and high-speed piston, especially in upright engines, where the acceleration of the piston is a high one. It may be that Mr. Van Vleck has overlooked this item.

Further on Mr. Van Vleck states that the employment of the condenser is more a question of finance than of engineering. As to this, I believe that it is not quite so. On the other hand, if that should be so, everybody knows that one can save money in this way, and it is very strange to overlook such an opportunity for saving money. There are cases where the erecting of condensers is expensive, for instance, if it is necessary to lay long pipe lines for the incoming and outgoing water, though that does not seem to be the case in New York. Nevertheless, if that is so, it is an outlay once for all which must be recovered in some years, in which I agree with Mr. Zehme. In the central stations of Berlin it was necessary to put in brick-lined canals conducting the warm water to the river Spree, but they did not shirk the expense, because they understood the necessity and subsequent advantages.

Another circumstance has not been mentioned, though it is productive of a great economy in steam, that is, the return of a corresponding amount of warm condensing water to the boilers, which can be done at a temperature of 180 to 200° F. With this, one gets extremely good results, and the firm of Gebr. Sulzer in Winterthur, Switzerland, probably the best steam engine builders in Europe, attained a consumption in this way with triple-expansion engines of less than 1.2 pound of coal per indicated horse power.

A good idea of engine building for electrical purposes was afforded by the late electrical exhibition in Frankfort, where the following upright condensing triple-expansion engine of the well-known firm of G. Kuhn, Stuttgart, was running:

Cylinder diameters, 20 inches, 28 inches, 78 inches; stroke, 24 inches; pressure, 142 pounds per square inch; revolutions, 80 to 100 per minute.

The machine had a capacity of 600 to 1,000 h. p., and worked with a very small consumption of steam.

The Van Vleck engine has the following dimensions: Cylinder diameters, 18 inches, 27 inches, 40 inches; stroke, 30 inches; pressure, 150 pounds per square inch; revolutions, 130 per minute; capacity, 500 to 800 h. p.

Evidently in this machine all the dimensions are the same or larger than the above, except the low-pressure cylinder; yet the maximum capacity is smaller by 200 h. p., that is, 20 per cent. This is due to the condensing.

I have not the space here to say more of Kuhn's very remarkable engine, and can therefore only refer to my treatise on them[1] published in the January number of the Vienna *Zeitschrift für Electrotechnik.* The treatise also contains tables showing at what speeds condensation was employed at Frankfort, and I stated that only once the number of 100 per minute was exceeded in using direct condensers. It is a fact that high-speed is unsuitable for the operation of pumps, although high-speed pumps are now being built. But there are resources enough to draw on, and it seems to me that Mr. Zehme also does not appreciate the value of an independent central condenser.

In all the numerous central stations of Paris central main condensers are used exclusively. The new station of the Compagnie Continentale Edison on the Avenue Trudaine, is a first class plant, and there is working there a main condenser with four steam engines, each of 300 h. p., and running at 130 revolutions per minute. The result obtained is a very good one, and the requisite attendance and inspection is a minimum. That is the modern method, to employ condensation in such stations where high-speed engines are in operation, and I cannot help thinking that this would have been a surer means to save money and produce electricity cheaper, having in view especially the projected enlargement of the Edison stations in New York.

THE ELECTRIC STORM OF JULY 16, 1892.

BY

W. Finn

I.

A MAGNETIC storm of unexampled severity and duration swept over the United States on Saturday, July 16, almost completly paralyzing the entire telegraphic service of the country for several hours. The writer had suspected the presence of abnormal earth currents in the wires on the morning of that date, and was engaged in making observations and taking readings for several hours prior to the advent of the storm.

Between 8 and 10 o'clock more or less difficulty had been experienced in operating many of the eastern and western circuits, and galvanometer tests had shown the existence of strong and variable earth currents in some of the wires. From 10 to 11 a. m. continuous observations were made on a New York-Boston wire in which the current showed incessant variations both in direction and magnitude, the latter averaging upwards of 10 milliamperes. Several tests between 11 and 12 showed similar variations in the polarity of the current though somewhat diminished in strength. Between 12 and 12:15 p. m. upwards of 150 changes in the direction of the current had been noted on a New York-Providence wire, during which time the current averaged 9 or 10 milliamperes.

Suddenly at 12:20 p. m. a tremendous wave struck the wire, which sent the galvanometer needle whirling around the scale and prevented further measurements being taken without the aid of a hundredth shunt. At the same instant every eastern and western circuit, as well as many wires in other directions, became either partially or wholly inoperative. A short while afterwards there was scarcely a wire in any direction, except local ones, that did not feel its effect, though here and there the curious anomaly presented itself of a circuit being operated between two points where other circuits between the same terminals were absolutely unworkable.

At 12:37 p. m. a reading obtained on a No. 6 iron wire to Boston, 213 miles in length and measuring about 3,700 ohms, showed a current strenth of 27 milliamperes, which increased to 32 milliamperes two minutes later, and continued to grow in intensity until it finally attained the unprecedented magnitude of 133 milliamperes at 12:40 p. m., representing a difference of potential between the two grounds of about 492 volts!

This was the highest E. M. F. observed; in subsequent tests many, however, exhibited currents of higher values in the wires than those given above. For instance, the current strengths noted in a wire to Elizabeth, N. J., rose from 55 milliamperes at 1:51 p. m., to 95 milliamperes at 1:55 p. m., and finally to a maximum of upwards of 150 milliamperes at 2:10 p. m., with an estimated E. M. F. at that time of about 210 volts. A wire to Philadelphia, measuring 900 ohms exhibited a current of 140 milliamperes, thus showing a potential difference of 126 volts between the distant grounds.

The writer knows of no record of any previous storm in which the voltage and strength of the earth current ever attained so high a value. The nearest approach in point of intensity is probably the electric storm of January 31, 1881, which developed a current of 41.4 milliamperes in one of the London-Irish wires, the highest E. M. F. observed being 120 volts in another wire between Haverford West and Valentia.

During the prevalence of Saturday's storm it was found possible, as is usual in such cases, to converse, and even send business over the wires without the aid of the ordinary artificially produced signaling currents. By 3 p. m. the disturbing forces had so far subsided as to admit of a resumption of working on most of the southern wires, as well as on several circuits in other directions.

About 4:15 p. m. another, but less powerful, wave struck the western wires but did not appear to further affect other circuits, hardly one of which, however, was entirely free from interruption. The storm continued to disturb the wires at intervals more or less frequent, and with varying degrees of intensity during the whole of the night, and did not finally disappear until the afternoon of the following day.

Sun spots are probably responsible for this latest extraordinary electrical manifestation, as they have been undoubtedly concerned in the production of similar phenomena in the past. The period of maximum sun spots which occurs about every eleven and a half years has always been associated with disturbances of this nature ever since the advent of telegraphy. The present year falls in the midst of a period when sun spots are most numerous, and already eleven electric storms have so far been recorded:

February 13, powerful and variable; March 6, comparatively mild; March 12, mild; April 24, April 25 and April 26, slight and sporadic; May 16, strong; May 17, mild; and May 18, very strong and exhibiting curious anomalies; July 12, strong, but comparatively steady; July 16, very powerful and very variable.

The principal characteristics of these storms are now so well known that it only remains to say that it is generally believed by scientists that the tremendous eruptive forces in the sun during these particular periods disturb the electrostatic lines of force radiating from our electrically charged globe, and thus create the conditions necessary for producing those great differences of potential between various portions of the earth's surface which give rise to abnormal earth currents.

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[1] Steam Engines at the Frankfort Electrical Exhibition.

II.

The discovery of the great sun spot of Saturday, July 16, at about the time of the abnormal earth current visitation on the same day, was an event that was confidently anticipated by those whose former experience of electric storms had led them to associate the one class of phenomena with the other. The coincidence affords another striking illustration of the close connection that exists between them, and leaves but little room for doubt as to the origin of the interesting though troublesome earth current.

Later advices from various sources confirm the first reports as to the wide extent and serious effect of the storm upon the telegraph service of the country. In addition to the high voltages observed on some of the local circuits, it is also recorded that in one of the wires between Chicago and Omaha, during the height of the disturbance an electromotive force was developed of about 270 volts, or more than double the amount ordinarily used on the circuit for signaling purposes. The intensity of the current was in fact so great in some instances as to raise the lamps in the dynamo leads to bright incandescence.

The disturbances noted were by no means confined to this country, and it will doubtless appear later, that, like all previous perturbations of exceptional violence, the recent storm will be found to have been quite cosmical in character. The cable service across the Atlantic was very greatly affected by it. These cables lie directly in the path of maximum flow, and, being operated by apparatus of great sensibility, are peculiarly liable to derangement and injury from such storms.

The comparatively weak and steady *normal* earth currents which are invariably present in these cables, are prevented from actuating the receiving apparatus—which is placed in the cross-wire of a Wheatstone bridge arrangement—by means of condensers interposed in the bridge wire, but the condensers afford no protection from the strong and violently fluctuating currents of an electric storm. It is usual at such times to cut out the apparatus and ground the cable; so that the latter may more readily discharge its accumulated electricity. The cable apparatus has suffered more or less injury from the effect of previous storms, and the recent occurrence proved to be no exception to the general rule, two coils having been damaged during the progress of the disturbance.

The cable circuits had felt the influence of the disquieting forces between 8 and 12 a. m. on July 16, but they were not of sufficient violence to cause a suspension of working until 12:16 p. m. when all the cables stopped together. The general effect produced by the electric waves upon the suspended coils which actuates the siphon attachment of the recording apparatus, was to gradually twist the coil to a position at right angles to that normally assumed, and to hold it there with the siphon off the recording slip until the wave reversed itself. At times the coil was swung backwards and forwards with sufficient vehemence to break the suspension fibres. One of the waves twisted the coil with a sharp click as though the cable had been struck by lightning. The shock was felt at the same time both at the American and at the European terminal points of the cable.

The time of appearance and departure of the cable currents as well as the characteristics exhibited correspond very closely with the observations made on aerial lines. The cables were, however, subjected to further interruptions from the same cause on Monday and Tuesday July 18 and 19, of which no record seems to have been made on land lines.

A circumstance worthy of note in connection with the disturbance which affected the western aerial wires on the afternoon of July 12, is the fact that the cable apparatus appears to have been indifferent to it. The writer can only account for this discrimination on the supposition that the currents—which on that occasion were singularly uniform in direction though varying in strength—were excluded by the condensers, which only transmit the impulses of *sudden* changes either in the polarity or strength of currents.

Observations during the past six months have shown the most remarkable changes in the appearance and general characteristics of earth current phenomena, and the many strange anomalies presented and curious effects observed make the study of this subject a peculiarly interesting and instructive one.

LORD KELVIN'S AMPERE BALANCES FOR VERY HEAVY CURRENTS.

As a supplement to the already considerable variety of ampere balances, Lord Kelvin has constructed two ampere balances for the measurement of currents up to 10,000 amperes for direct and alternating currents. The serious if not insurmountable difficulty of handling such heavy currents through movable contacts, as is done in the well-known types of ampere balances for currents up to 2,500 amperes necessitated a different construction inasmuch as the main current passes through heavy copper bars or tubular cables (in the ampere balance for alternating current) whilst a known, small current energizes two movable coils connected to the beam of the balance.

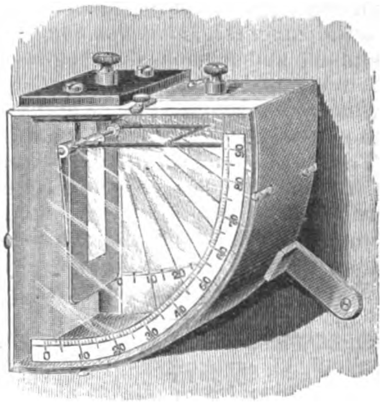

FIG. 3.—LORD KELVIN'S GOLD LEAF ELECTROSCOPE.

Fig. 1 shows the ampere balance for direct currents up to 10,000 amperes. The conductor for the main current consists in this type of heavy copper bars arranged in two rectangles, one above the other. The current entering at the upper right-hand terminal passes through the upper rectangle in the direction of the hands of a watch, thence through a connecting piece into the lower rectangle circulating through this in opposite direction to the hands of a watch and leaving at the lower right-hand terminal. The two movable coils are suspended in the usual way within the space between the two rectangles. The resistance of these two fine wire coils is 10 ohms and the wire is so dimensioned that it may carry currents up to 1 ampere without heating. In series with the fine wire coils a resistance box can be used containing steps of resistances up to 400 ohms.

In connection with this resistance box, the instrument constitutes a wattmeter with a sensibility of 50 to 2,000 watts per division of the scale engraved on the beam of the balance, the sensibility depending upon the respective steps of the resistance box.

To use the instrument as an ammeter for general purposes where the required accuracy is not limited to a small amount it is sufficient to measure the fall of potential at the terminals of the fine wire coil with a good voltmeter and divide the readings in watts by this potential difference. If greater accuracy is required, it is preferable to measure the current passing through the fine wire coil with an auxiliary accurate instrument; for instance, a centi-ampere balance. Since the movable coils can carry currents as high as 1 ampere, the sensibility of the instrument may be varied between very wide limits, so that the constant of the instrument for one degree of the scale may be made anything from 0.1 to 20 amperes, affording a range from 0.1 to 12,000 amperes.

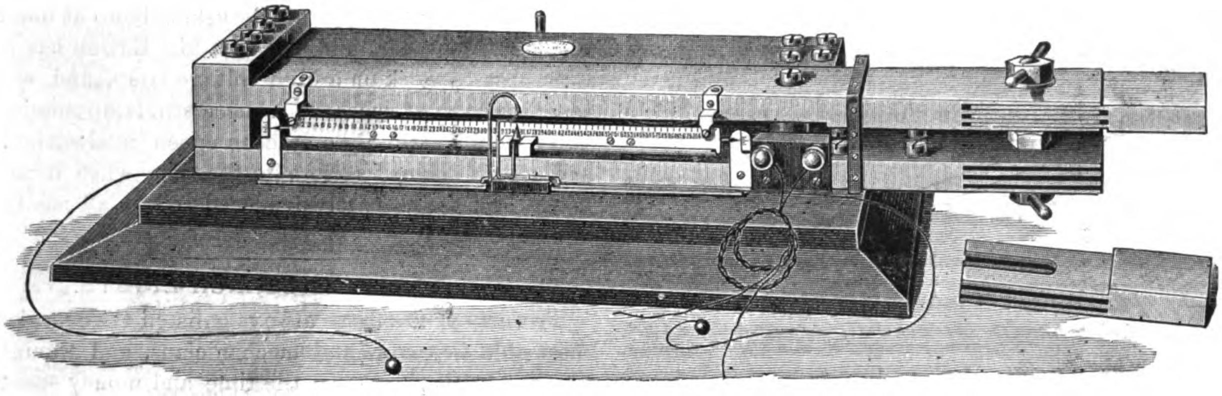

FIG. 1.—THE KELVIN 12,000-AMPERE BALANCE.

In the ampere balance for alternating and direct current, shown in Fig. 2, the main current passes through a U-shaped tubular conductor, made up of a number of insulated wires connected in multiple. In order to prevent the effects of mutual induction of the two parallel parts of this conductor, the insulated wires constituting the conductor are twisted in such a way that those parts which are on the inside in respect to one of the movable coils are on the outside with respect to the other, and *vice versa*. Brass tubes extend through the whole length of the interior of the conductor up to the bend of the U. These brass tubes serve to hold the conductor in position and also afford simple means of ventilating the conductor with a current of air by attaching a pair of bellows to one of the small brass tubes shown on the left-hand side of the conductor.

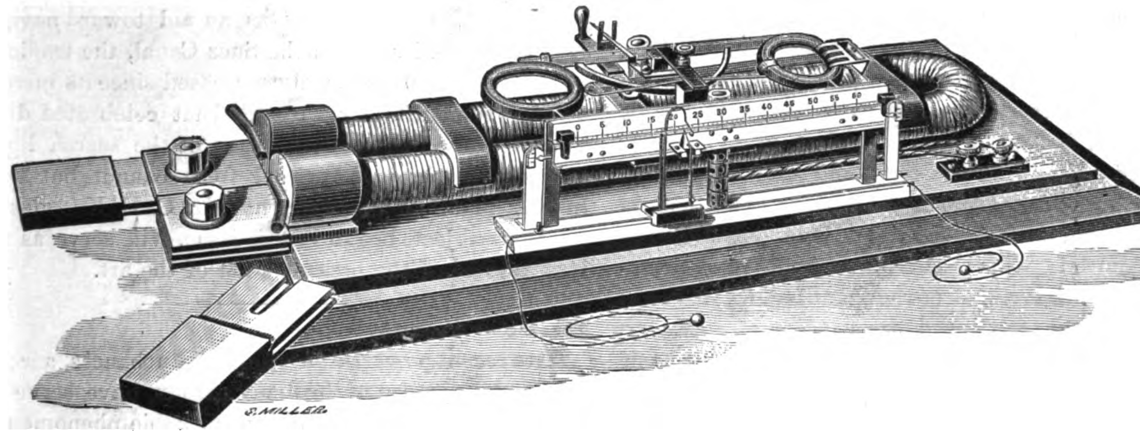

FIG. 2.—KELVIN AMPERE BALANCE FOR DIRECT AND ALTERNATING CURRENT.

In Fig. 3 is shown a simple and improved gold-leaf electroscope of the same distinguished inventor. This instrument is intended for practical purposes and may be used as an electroscope in experimental work, for instance, or may very well be employed as a ground detector by indicating continuously the difference of potential between the ground and one or the other line conductors. Its construction is clearly shown in the illustration. In front of a brass plate connected to the binding post on top of the vase and insulated from the vase, a gold leaf is suspended, which, as in the well-known cruder instruments, will be repelled by the brass plate as soon as both receive a charge. The case consists entirely of metal with the exception of the glass plate in front. A degree scale is engraved on the rear of the inside of the case and another, to similar scale, is fastened against the inside of the glass cover. With this double scale parallax in reading is avoided. One side of the vase is given a cylindrical shape in order to increase the sensibility by a mutual action between the case and gold-leaf by induction. A light frame hinged to the brass plate and shown in a horizontal position in the illustration serves the double purpose of protecting the gold-leaf from injury in transportation, pressing it against the brass plate when the frame is turned down. Otherwise in its horizontal position it acts repellingly upon the gold-leaf, preventing the latter from touching the vase, if too high a difference of potential should be applied. The instrument is of course only a rough and empirical indicator and gives readings from 500 up to 5,000 volts.

LIGHTING THE THAMES EMBANKMENT BY ELECTRICITY.

IT is proposed, says *Engineering*, to light the Thames embankment by electricity. It is suggested that lamps of 1,000 to 2,000 c. p. should be placed on the centre line of the roadway, about 50 yards apart. The capital expenditure is put down at £10,000, and the annual outlay for maintenance, working expenses and depreciation is estimated at £2,000.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can 'entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. XIV. NEW YORK, JULY 27, 1892. No. 221.

There is a great difference between reading and study; between the indolent reception of knowledge without labor, and that effort of mind which is always necessary in order to secure an important truth and make it fully our own.—Joseph Henry.

A TWO HUNDRED VOLT INCANDESCENT LAMP.

THE indroduction, by Mr. Edison, of 110 volts as a standard of potential on incandescent circuits was one of the numerous details which went to make up the system of electric lighting worked out by him. To many people it might appear that the selection of this potential was an arbitrary one, but such, we may assert, was not the case; indeed it was a subject of much consideration by Mr. Edison at the time, and may be said to have been a compromise between the various conditions as they existed at the moment when incandescent lighting was first introduced. Now that improvements in generating apparatus, insulation, and in the manufacture of lamps themselves have been introduced, the question of operating higher voltage lamps is one which naturally obtrudes itself upon the electrical engineer, for the economy in copper obtainable with a 200-volt lamp over that with a 110-volt lamp is too obvious to need further pointing out. An easy solution of the problem apparently would be the mere lengthening of the filament of the lamp, as ordinarily made, in order to adapt it to the increased potential, and it seems that lamps of this type have been employed with some success abroad, as noted in another column; but we also learn that the life of these lamps is said to be shorter than those of lower potential. We are quite prepared for this statement when we recall the experiments made by Mr. Edison, and others, which went to show that at a potential above 150 volts a brush discharge takes place between one side of the filament and the other, which very soon causes its destruction. The action is in the nature of an electrolytic deposit from one to the other, and is accompanied by a heavy blackening of the bulb, the brush action being especially marked at the points where the leading-in wires are sealed. It is quite possible that much of this difficulty might be overcome by the employment of a perfectly straight filament, with the ends separated as far as possible and resembling the type of Bernstein lamp at one time in vogue. We understand also that Mr. Edison has for some time been at work on a high voltage lamp, and with quite some measure of success. A successful lamp running at 200 volts would certainly create an epoch in electric lighting and would bring us close to the time when incandescent lamps will have entirely displaced gas in all possible cases of competition.

ELECTRIC SEARCH LIGHTS.

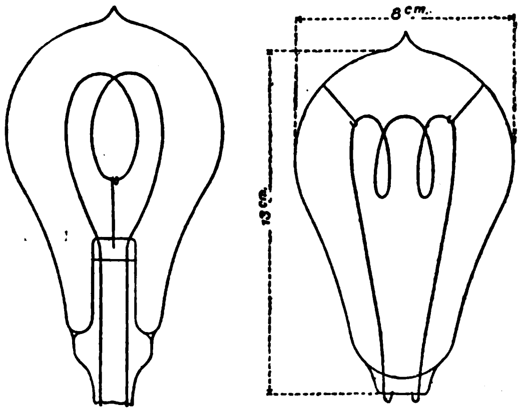
THE arts of war have always enlisted the energies of the most able inventors and mechanicians, and though many perhaps justly deprecate the time and money spent in the production of war material, and the education of men in the arts of killing, the fact cannot be denied that the peaceful arts have gained not a little from the work of the army and navy. We need not go far to find examples of this in the domain of electricity, as in almost every instance the work of the electrical engineer has been taken up by various governments and encouraged. A noticeable instance of this is the perfection which the manufacture of electric search lights has attained under the fostering care of the various naval establishments. From the most crude beginning this apparatus has now reached a stage of perfection which it appears difficult to surpass, not only in the remarkable control of the arc itself and the maneuvering of the light but also in its optical qualities. The search light, however, is gradually, but steadily, coming into use on board vessels of the commercial marine both sea-going and river craft, and its value as an aid toward navigation is well shown in its use on the Suez Canal, the traffic receipts of which have been largely increased since its introduction on the vessels passing through that celebrated ditch. In view of these facts a description of the search light as it exists to-day in its improved form cannot but be of the highest practical interest, and Mr. C. E. Knowles's article on this subject, begun in this issue, will serve as an excellent résumé of the present state of the art.

The Recent Magnetic Storm.

THE recent powerful magnetic disturbances, accompanied by the appearance of brilliant auroræ, have served to call attention once more to these remarkable phenomena and to emphasize the intimate connection between our planet and the sun. The variety of the phenomena observed, both of an electrostatic and an electro-dynamic nature must necessarily make a comprehensive theory as to their cause difficult. The recent auroral displays, however, have exceeded in intensity all previously recorded observations, and the new data, together with past records, gradually accumulated, may eventually serve to throw light upon this still obscure manifestation. We commend Mr. Finn's article to our readers' attention.

200-VOLT INCANDESCENT LAMPS.

A recent note which appeared in our excellent contemporary, *L'Industrie Electrique*, called the attention of electricians to the employment of 200-volt incandescent lamps. It was maintained by the writer that nothing stood in the way of the manufacture of such lamps, for if it be possible to construct a 100-volt 10 c. p. lamp it would be an easy matter to obtain a 20 c. p. lamp by the use of a filament of the same cross-section, but of twice the length. Commenting on this, in the same journal, M. André Larnaude calls attention to the fact that the only difficulty encountered is due to the mechanical qualities of the filaments. The great length which is necessary to employ renders them very flexible and they soon bend over and touch the bulb and break it, if care be not taken to support them at one or more points by platinum hooks. As shown in the accompanying illustrations, Figs. 1 and 2, the supporting hook is carried by the tube carrying the leading-in wires, or fixed in the upper part of the bulb. This extra work, joined to the minute precautions necessary during manufacture on account of the delicate nature of the filaments, increases the cost of the 200-volt lamp, and this fact has been one of the chief causes of their limited employment. It is also to be feared that in operating these lamps a practical difficulty may be encountered resulting from bad insulation in the bases and sockets. However, the trials made with these lamps in installations put up with care allow of the belief that it is not necessary to make use of any special apparatus.



Figs. 1 and 2.—French Edison-Swan 200-Volt Lamps.

We give below the principal dimensions of the three types of such lamps manufactured by the French Edison-Swan Co.:

C. P.	P. D. in volts.	Amperes.	Watts per c. p.	Length of filament in cm.	Resistance in ohms.
16	200	0.31	3.90	27.5	1,200
20	200	0.38	3.80	29.0	1,000
32	250	0.50	3.90	27.5	770

The lamps are mounted and put in service in bayonet sockets. M. Larnaude does not give any definite results as to the life of these lamps, but remarks that their life seems to be shorter than that of the ordinary type. This, he suggests, may be due to lack of homogeneity in the filaments, which are more likely to occur in a long filament, or to increase in the electric dissipation of the filament and deposit of the carbon on the interior of the bulb.

EXHIBITION OF ELECTRICAL APPARATUS.

The committee of arrangements of the annual meeting of the American Electro-Therapeutic Association, to be held October 4, 5 and 6, at the New York Academy of Medicine, 17 West Forty-third street, have decided to have an exhibit of medical electrical apparatus in connection with the meeting, and have arranged to accommodate the manufacturers with suitable space in a room adjoining that where the meeting will be held. The choice of space will be given in the order of application, which should be accompanied by a voluntary subscription of not less than $10, or a promise of compliance on demand. Each subscriber will be furnished with a space 5 x 6 feet, which may be exceeded, if desired, by a proportionate increase in the amount subscribed. Publishers of books upon medical electricity are invited to apply for space upon the same conditions as manufacturers.

An exhibition will be held on Tuesday, Wednesday and Thursday, October 4, 5 and 6, commencing at 9 o'clock each morning. Robert Newman, M. D. and Augustus H. Goelet, M. D., constitute the committee.

CARBONS.[1]

BY H. O. FISK.

It was suggested at one of our committee meetings that I should prepare a paper for this convention on "Carbon Testing," but the time was too short to carry out a series of experiments as at first spoken of, so instead, I have prepared a short description of the process of manufacture of carbon points, as conducted at the factory in Peterborough.

Twenty-five per cent. of gas coke mixed with 75 per cent. of petroleum coke, is said to make a good carbon for low tension work. Another variety of this material is obtained from the oil regions, commonly known as petroleum coke. This is a by-product of the oil stills, and is the only kind used to any great extent in the manufacture of carbon points for the electrical industry. It is of primary importance that the coke, and, in fact, all the ingredients used, be absolutely free from impurities. The other constituent of our carbon is pitch. This is made from coal tar, which is a by-product of the gas retorts. It may also be obtained from blast furnaces, but this kind is more or less contaminated with iron, and therefore is unfit for this class of work. Pitch for this particular purpose is difficult to obtain, as the makers do not care to expose their still to the high temperature necessary to drive out all of the oil and reduce it to the proper specific gravity, and as the men in the factory say, "it is more or less wet."

The first step in the process of manufacture is that of crushing the coke. This is accomplished by means of a machine somewhat in appearance like a mammoth coffee mill. The coke comes from this crushed to about the size of coarse gravel; it is then automatically elevated to a large bin in the upper part of the factory, and from there it is conveyed to a large iron hopper situated directly over the calcining retorts. Into these the granulated coke is conducted by means of spouts with gates arranged to control the flow of material into the several aforementioned retorts. They are then sealed up, thereby preventing combustion, with the exception of a few vents to allow of the escape of gas, arising from the heating of the coke to a state of incandescence, which point is reached in from twenty-four to forty-eight hours after firing. After this if the coke is not pure it will be found to have caked, necessitating in some cases the use of bars to break it up sufficiently to allow of its being drawn from the retorts. If pure it will appear crisp and dry and to have suffered a loss in weight of about 30 per cent. After the retorts have been drawn sufficiently long to allow of cooling, their contents are elevated to the milling department and run through a set of French burr stones incased in iron, very similar to the grist mill chop stones; then through a silk bolter separating the coarse from the fine, the former returning to the milling machine, the latter being conveyed to bins with suitably arranged spouts over scales from which it may be drawn and weighed as required by the mixing department. We will leave the coke here for the present and return to the other ingredient, namely, the pitch. This is dense, hard, solid, very brittle and dry, and in appearance somewhat resembling gutta-percha. This material, when it reaches the factory, is incased in casks, holding about 600 lbs. each. It is then broken up by the men into a convenient size for handling, and subjected to a granulating process similar to that of the coke; finally we find it at a spout close beside the one from which the coke can be drawn.

We have now followed the two principal ingredients through the various processes which were necessary to prepare them for the mixing-room. The other ingredients, if any, we shall not be able to elaborate upon, until we have reached a more confidential relationship with the carbon makers. However, upon the manipulation of the materials at this stage, I am told the success of the future carbon greatly depends, in fact, the great secret lies in the mixing. We can better understand the skill and care required to properly amalgamate the mixture, when we learn that each particle or grain of coke must have its individual coating of pitch, and it may be interesting to learn that this coke is ground so fine that a grain magnified a thousand times would only appear the size of a shot. To obtain these results the materials are carefully proportioned by weight, and placed in a mixing barrel. This is a rotating cast-iron cylinder within which in the same direction revolves an independent shaft, twice as fast as the cylinder, to which are attached arms so arranged that every part of the barrel is covered or swept in each revolution. This is attached to a furnace in such a way that the flues follow the whole circumference of this barrel, maintaining a uniform temperature of about 300° F., which is necessary to bring the pitch to a state sufficiently plastic for amalgamation; thirty minutes is the time required for each batch, which would make about 1,600 carbons. From this machine it is taken to the cooling-room and spread out for ten or twelve hours to cool. Here the mixture solidifies to such an extent that it becomes necessary to pulverize it again, to perfect it for the moulds. This end is attained by means of a mill, the pulverizing feature of which is two discs thirty inches in diameter, with corrugated face plates revolving in opposite directions at the rate of fifteen hundred revolutions per minute (about one one-hundredth of an inch apart). From this it is once more passed through a bolting machine, and then finding its way down gravity tubes to a bin on the floor below (which is the moulding-room) it is carefully weighed out by the workmen on peculiar little scales with clock-like dials, in quantities just sufficient to fill each mould as it comes hot from the oven.

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[1] Abstract of a paper read before the Canadian Electrical Association, June 15.

The mould having been previously lubricated with some heavy oil, is now ready for its charge, which the operator places in it and works evenly over the whole surface with a spatula, to insure uniformity of density. The cover or top half is placed in position and the mould and its contents pass for a few moments into an oven, the temperature of which is about 300° F. As soon as the mixture has become quite adhesive the mould is placed in the hydraulic press, and subjected to a pressure of several hundred tons. The mould is now removed and opened, and we have a corrugated card containing sixteen or eighteen carbons, each one being joined to its neighbor by a fin which is inevitably formed when subjected to the enormous pressure before mentioned. These cards are placed on plates which are fitted to receive them perfectly. These plates with their contents are piled up and weights placed thereon to prevent warping. When cool they are broken apart, gauged for size, culled, and the fin scraped off. They are then laid in the furnace for baking. This furnace is rectangular in shape 84 x 11, four feet deep and made of fire-brick, and is similar to a large vat set about two-thirds below the surface of the earth. Over this when filled is placed a dome-shaped cover, sufficiently high above the sand and tile which covers the carbon, to allow of a free passage of the flames, and which is continued by flues back through the sides and also underneath, thus completely enveloping the body of the furnace in flames. The carbons are carefully placed in the furnace and separated from each other with washed sand, which is brought from the shores of Lake Ontario. Some days are required to completely load a furnace, as each section will hold about seventy-five thousand carbons.

The cover having been placed in position and sealed with fire clay, the fire is now started, crude oil being the fuel used, as well as in the case of the retorts and moulders' oven. This fire is continued moderately for 48 hours to allow of the gas escaping without blistering the carbon; it is then forced to its utmost for from forty-eight to sixty hours longer, then shut off, and the whole allowed to cool for forty-eight hours before uncovering. The top, which is mounted on wheels, is then rolled off and a few carbons taken from various parts of the furnace and tested by a Wheatstone bridge and galvanometer for resistance, as this at once determines if the baking has been carried sufficiently far. If the measurements of all the samples exceed four-tenths of an ohm, the furnace is re-covered and fired for some hours longer, but this very rarely has to be done. The writer recently tested samples from the north and south ends and centre of a furnace, and they measured 23, 22, and 24 one-hundredths of an ohm respectively. Some difficulty was at first experienced in attaching carbons to the bridge, for the resistance of this substance varies considerably with the pressure of contact, and the same carbon measured at different times would often vary several one-hundredths of an ohm. But an instrument was designed by the writer which obviated to a great extent if not wholly this trouble. The pressure brought to bear, on the sample undergoing test by this instrument is determined by small weights suspended from levers attached to holders so arranged that exactly the same pressure and contact is formed on different samples of the same size. If the resistance of the samples, as before mentioned, shows that the contents of the furnace have been sufficiently baked, it is unloaded, the hot carbon being handled with forks.

When cold they are sorted, the first and seconds being easily determined by rolling on level steel plates. After this inspection they are ready for the plating-room, where they receive their copper coat by being hung in leaden vats containing a saturated solution of sulphate of copper. These vats, of which there are several dozen, are connected in series with a twenty-ampere constant current dynamo. Twenty minutes to half an hour is the time required to complete this plating process. They are then washed in hot and cold water and placed on racks to dry, after which they go to the packing department to be rolled in paper and boxed for shipment.

Letters to the Editor.

THE RELATIVE VALUE OF EXHAUST STEAM.

In a recent article in the London *Electrical Review*, Mr. W. H. Booth attemps to controvert my brief argument in THE ELECTRICAL ENGINEER of June 1, showing the financial advantages of the sale of exhaust steam over the constant use of condensers in connection with central station work. I hardly know which to admire most, Mr. Booth's apparently self-satisfied ignorance and assumption in regard to the subject in hand, or his flippantly "tricky method" of perverting the figures used in my article. Mr. Booth says: "Very many boilers throw away half the heat units, and the steam as it goes to the engine only takes with it the other half." And so he proceeds to debit the engine with only one-half of the total heat units generated in the boiler.

My article did not discuss the economic features involved in the use of different boilers; it did not attempt to compute the possible heat units that could be extracted from the coal bunker by the most approved appliances, and such a calculation would be entirely foreign to the question under discussion. But what we have to deal with is the steam which actually reaches the engine in a given case. Let that be represented by 100. Seven to ten per cent. of the contained heat units only is used by the best plain cylinder engine; the total remaining 90 to 93 per cent. less the radiation from the engine is lost in the exhaust. Compound the engine and save two to three per cent. more; add condensers and three per cent. more can be saved; total 12 to 16 per cent.—provided free water without pumping can be had for condensing. Against this amount saved must be charged the compound and condensing apparatus. All the remaining heat units are in the stream of hot water flowing from the condenser. This is fully 80 per cent. of the units of heat which were in the steam delivered to the engines, and my proposition was to sell this 80 per cent. or more for heating buildings, which has a value as stable as any commodity with which we deal.

I did not propose as he says, to run non-condensing for twelve months for the sake of selling exhaust eight months, but the plan as stated was, where condensers are in use, to disconnect them during the eight months and to run condensers during the remainder of the year. If Mr. Booth had read Mr. Collins' excellent article in the June 1, number of THE ELECTRICAL ENGINEER he could have learned where this plan is in successful operation—fact against theory. And the statement is made that "the profits from this branch of the business are twice what they are from lighting or power."

Mr. Booth raises the question of back pressure upon the engine where the exhaust is forced through long lines of pipe, and is in doubt whether there will be any "go" in the steam at the terminal points. If his attention had been directed to the article before mentioned, he would have learned that with a back pressure of five pounds at the engines, large blocks of buildings were being heated, and still there was plenty of "go" at the terminals, and ready to do still further service. We all know the facility with which gas is distributed through long lines of pipes. Steam under pressure is a quasi gas and invisible, and all who are posted know that the loss of pressure by friction in pipes of medium size, say one-half mile in length, does not exceed five per cent., nor is the percentage of loss by condensation greater, where the best approved methods are followed in protecting the steam pipes.

To circulate exhaust steam then, the station manager simply needs to increase his initial boiler pressure by from five to ten pounds. The additional cost of generating steam at an increase of ten pounds pressure is known to be trifling, while there is no further added cost for energy in effecting the circulation. There is nothing complex about this, and nothing could be more economical in effecting results. Mr. Booth is unfortunate in being compelled, through lack of information, to theorize upon matters which have been already settled by facts based upon experience.

From these doubts, difficulties and dangers in which Mr. Booth has enveloped himself, he escapes by making a marvelous discovery, which is: "To heat water to 130 degrees by the steam and send the water round in the pipes to consumers." The water, he says, "would flow to consumers without any more expense of energy than it is now given to flow to them cold." That means, I suppose, the usual water pressure of 50 to 100 pounds which is required to overcome gravity and friction. He did not tell us how much extra boiler power would be required to simply pump the water; as it certainly would not "flow" to the upper floors of high buildings without pressure behind it. Under the same pressure the rapidity of flow in water is as one to fifty for steam. So that unless very high pressure were carried, say, 300 to 400 pounds, the water pipe would require to be the larger, and the same device being required to take care of the expansion and contraction, Mr. Booth would find his system of water circulation to be enormously expensive. Mr. Booth says that this "method of using and selling heat has not yet been attempted." I regret to destroy his claim to priority of invention. If he had been properly informed in this matter of water circulation he would know that the system was attempted on a large scale in Boston three or four years ago. A very large amount of capital was enlisted and the most elaborate devices employed, but for the reasons I have given, the cost of operation being out of all proportion to possible revenue, the enterprise was a total failure and was abandoned.

Mr. Booth, I judge, enjoys the lacteal fluid supplied by his milkman well charged with water; most people prefer straight plain goods whether milk or steam. He evidently has adopted dilution as a principle, which accounts for his mixture of a small amount of fact with a large supply of fiction, and figures which prove nothing.

I. H. BABCOCK.

LOCKPORT, N. Y., July 18, 1892.

MERCURY *vs.* MECHANICAL PUMPS FOR EXHAUSTING INCANDESCENT LAMPS.

IN an article on "Exhausting Incandescent Lamps by Means of Mercury Pumps," in the July 20 issue of THE ELECTRICAL ENGINEER, just to hand, I note that Mr. Packard quotes a paper by Prof. B. F. Thomas on "A Life and Efficiency Test of Incandescent Lamps," read at Chicago during the recent session of the American Institute of Electrical Engineers to support his belief that a mechanically exhausted lamp will blacken more than a lamp exhausted by mercury. An inspection of Prof. Thomas' paper will show that such a conclusion as is drawn by Mr. Packard from Prof. Thomas' remarks cannot be sustained. Mr. Packard says: "In the recent test by Prof. Thomas * * * lamps which are exhausted by the mercurial process showed considerably less blackening that any of the other makes, among which was the * * *, exhausted by mechanical process." In the paper of Prof. Thomas, as printed in THE ELECTRICAL ENGINEER of July 13 (bottom of page 89, right-hand column), we find in italics the remark by Prof. Thomas: "*The two lots which were least blackened were of the makes which are advertised as exhausted by mechanical pumps.*" This apparent error of Mr. Packard's is very probably due to an oversight.

As a tyro in lamp work I may say that in some experiments made by myself last fall with a view to developing a powerful incandescent lamp for stereopticon work I met with the same results as are indicated in Prof. Thomas' paper. In every case a mercury exhausted lamp blackened far more rapidly than one exhausted by an orthodox mechanical pump. My lack of experience in this sort of work might, of course, be made to account partly for such results, as I may have neglected some precautions exercised by practised makers.

PHILADELPHIA, PA. ELMER G. WILLYOUNG.

(With regard to the above, we may say that just after the forms had gone to press last week, containing Mr. Packard's article, he wrote us, asking that we omit the paragraph referring to the Thomas test on lamps at the Ohio State University. Mr. Packard says: "I had Prof. Thomas' letter as authority for the statement made in this paragraph, but judging from his later publication, there is apparently some mistake about it. The rest of the article is all right." EDS. E. E.)

VACUUM LIGHTNING ARRESTERS.

IN your last edition there appeared a request for information concerning lightning arresters, which consisted of either exhausted or simple glass tubes.

I am able to state that an arrangement of partially exhausted glass tubes has been tried, in that direction, the credit of the idea being due to Mr. R. G. Fessenden.

The arrangement consisted of a sealed glass tube which had been partially exhausted, the arc being formed between two small wires, which were sealed into the tube. Upon the arc forming, the air in the tube expands suddenly, shatters the glass, and the arc is extinguished. The arresters are arranged in banks of half a dozen, so that the line may be struck as many times in succession, the result being merely the destruction of an extremely cheap piece of apparatus.

LOYALL A. OSBORNE.

NEWARK, N. J.

MR. J. H. VAIL, of the General Electric Company, presented recently before the citizens of Westfield, N. J., an able address on the subject of a water supply for that beautiful town. The address has attracted much attention and has now been issued in pamphlet form. Mr. Vail's residence is a fine farm, with modern mansion, in the suburbs of Westfield, and he lights the grounds and premises with incandescent lamps, taking current from the Thomson-Houston plant at Elizabeth nearly eight miles away. He has set an example that will find many imitators among the wealthy inhabitants of Westfield.

Literature.

Die Einrichtung Elektrischer Beleuchtungsanlagen für Gleichstrombetrieb. (The Equipment of Direct Current Installation) By Dr. Carl Heim. *Leipzig*, 1892. Oskar Leiner. 503 pp., 5½ x 8½ inches. Paper. Price, $3.20.

German electrical literature has produced quite a number of excellent treatises on the construction of dynamo-electric machinery, but up to the present, none had appeared which gave the reader a thorough insight into the actual methods employed in the erection and operation of electric lighting plants in Germany, and hence the present work occupies a distinct position. Dr. Heim introduces the subject by an exposé of the fundamental ideas involved in the continuous current in which, of course, the law of Ohm occupies a prominent position, and then leads up to the relation between electrical and mechanical work. Then follow excellent descriptions of the various types of machines built in Germany, with much practical data regarding their construction. The storage of electricity is then taken up and the principal cells described, together with the manner of their employment in isolated and central station work. A number of diagrams are shown in this part, illustrating the method employed in Germany, where, by the way, much more has been accomplished with accumulators than in this country.

The author then takes up the subject of arc lamps, describing the various types, both for series and incandescent circuits. This is followed by an exhaustive treatment of incandescent lamps and their application, both in series and parallel lighting. The author has laid particular stress upon the regulation of incandescent circuits on extended networks, describing and illustrating a variety of apparatus for regulation at the feeder ends. The remainder of the book is largely devoted to auxiliary apparatus employed in electric lighting, such as switches, sockets, accumulators, interior conduits, ammeters, voltmeters, lightning arresters, lamp posts, etc. There is also a short treatise on the management of stations, and to this is added full information regarding the cost of installation of various kinds, so that the book as a whole affords an excellent opportunity for comparing American with German practice. The illustrations throughout, numbering over 300, are very clear, and the work has evidently been prepared with great care in all its details. Our own manufacturers might obtain not a few useful hints from its perusal.

Local Transportation and Underground Conduits. Reports of the Consuls of the United States. No. 139. April, 1892. Bureau of Statistics, Department of State. Government Printing Office, Washington, 1892.

THIS is a compilation of two distinct branches which are nevertheless closely allied in the work which the electrical engineer is now called upon to carry out. With the growth of local transportation in the United States the methods as employed abroad will be of value, for even if the amount of such work, effected by means of electricity abroad, is practically nil, the ways and means of carrying on local transportation in foreign countries nevertheless affords an excellent basis of comparison with our own.

The reports on the underground systems are, for the most part, brief, and, with one or two exceptions, very superficial. An exception to this is that from Deputy Consul Sherman, of Liverpool, who gives a very good account of the work done in that city. Strange to say, the report of the consul at London is confined entirely to the description of the English Postal Telegraph underground system, no mention being made of the considerable underground work of electric lighting companies. We also notice that the consul general acknowledges the courtesies of Mr. William H. Bruce, chief electrician of the British postal telegraphs, for valuable information furnished. Mr. Preece's many friends, however, will have no difficulty in recognizing the printer's bull. The report can be had on application at the Secretary of State, Washington.

Bericht über die Verhandlungen des Internationalen Elektrotechniker-Congresses zu Frankfurt am Main, vom 7. bis 12 September, 1891. Part I. Report of the General Meetings. Frankfort a. M. 1892. Johannes Alt. 143 pp., 7½ x 11 in.

Les Nouvelles Installations de l'Institut Electrotechnique Montefiore. By E. Gerard. *Liége*, 1892. Imprimerie de la Meuse. Pamphlet, 20 pp.

Proceedings of the Naval Institute. Vol. XVIII., No. 2, 1892. Published by the Institute. Annapolis, Md.

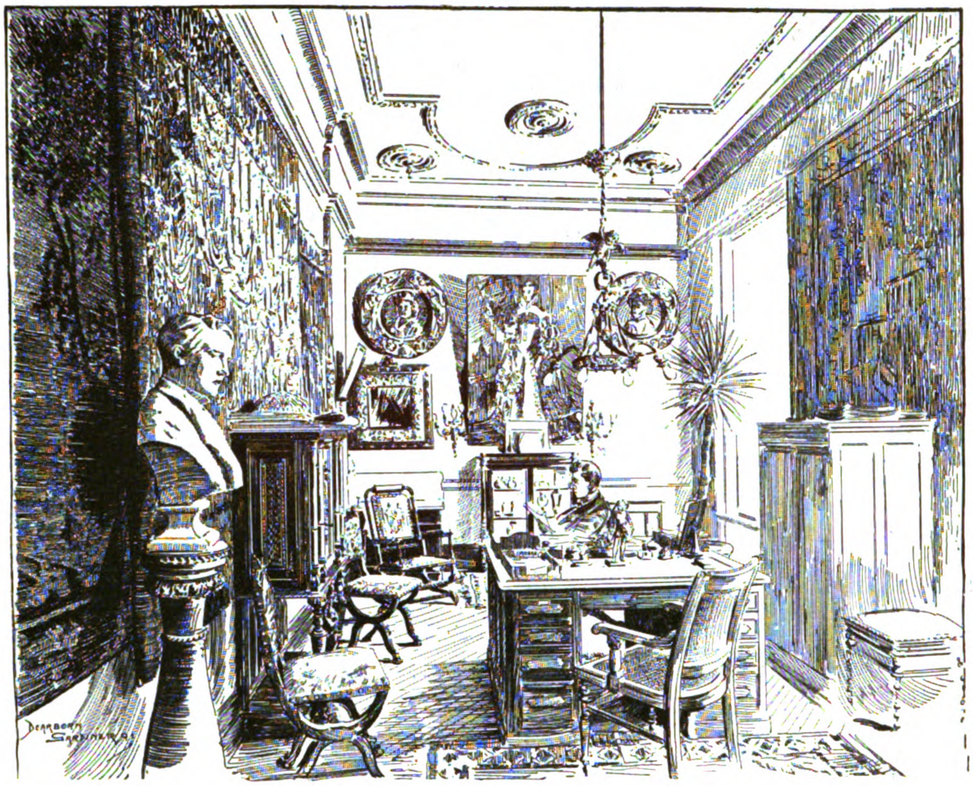
MR. CHARLES C. UPHAM, general manager of the Lincoln Street Railway Co., Lincoln, Neb., was a Chicago visitor last week.

THE NEW YORK ELECTRIC EQUIPMENT CO.

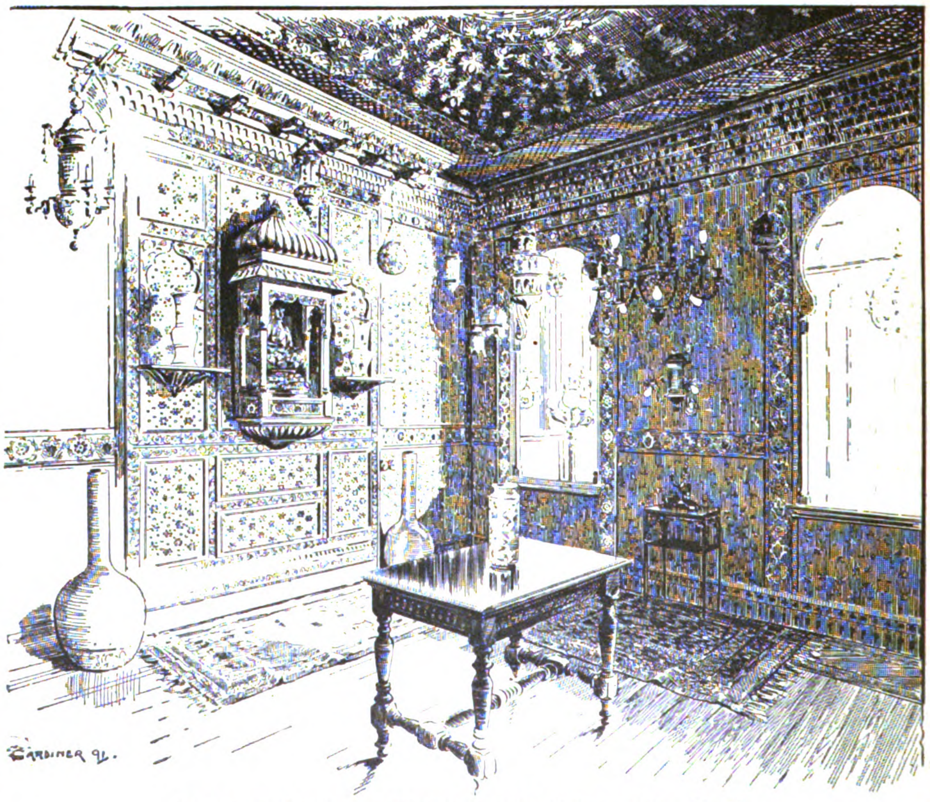
One of the most important recent departures in the electrical development of New York City has been the organization of the New York Electric Equipment Co., with Mr. Sigmund Bergmann as president and general manager, Mr. P. H. Klein as secretary and treasurer, and Mr. Augustus Noll as general superintendent. This concern will, it is understood, do all the interior and installation work within the territory of the Edison Electric Illuminating Co., under the Edison patents and privileges, and will carry on an extensive business in the line of supplies, fixtures, apparatus, etc. It has the whole of the large Acme Building on Duane street, adjoining the new Edison station, as offices; storerooms at 431 Fifth avenue and in the Edison Twenty-sixth street station; and the beautiful fixture and electrolier department at 275 Fifth avenue, where all the fashionable styles of fixtures are shown and where orders are received for special designs and electrical decorations. Our engravings on this page illustrate two of the rooms at 275 Fifth avenue, showing how each room is fitted up to exemplify the various styles and finishes. One is a view of the Oriental room, and the other shows a library or office. The whole of the designs and furnishings are in exquisite taste.

The officers of the New York Equipment Co. need no introduction to the electrical public. President Bergmann has been a pioneer manufacturer in a great many branches of the light and power industry, and no name in the fixture and supply line is better known in America, while he also enjoys a wide European reputation. Mr. Klein's association with the electrical field is also of long standing, and he has every qualification for his post. Mr. Augustus Noll, while perhaps the youngest, is one of the most experienced electrical engineers of the day in wiring work, while his familiarity with the various branches of installation dates back to the very beginning of electric lighting. Some idea of the activity of the company may be formed from the fact that they have no fewer than five large gangs of men at work in different parts of the city, all under competent foremen and receiving Mr. Noll's direct personal supervision. The company does not touch outside or underground work, but in inside work takes contracts for everything in a plant, including engines, boilers, dynamos, wiring, fixtures, lamps, and all details, complete. It proposes to do work of one class only—the best. One feature is the filing away of all plans carefully, as architects do, so that if changes are required in any building at a later date, the plan is there for reference. Nothing is left to chance or guesswork. So, too, in fixture work, the company is prepared, with the best designers, to execute original ideas, and to provide special fixtures to correspond with the architecture or fittings of any building.

It will be seen that the work of the new company is very comprehensive, and covers all the many features that now enter into electric light and power consumption in large cities, as well as touching, upon the other side, many of the most important details of supply manufacture. It would seem to be an excellent plan for any large local company to concentrate its energies and ability upon the economical production of current, leaving to a responsible concern like the New York Electric Equipment Company the care of all the multitudinous matters that have no more to do with current generation than the production of gas has to do with gas piping, gas stoves, or gas engines. The new departure has been well and wisely made, and it may fairly be expected that it will do much to hasten the time when every New Yorker will be able to enjoy the incandescent light in his home and sit in the breeze of his own fan motor. A great deal has been done in New York electrically, but the larger part is still awaiting development.



N. Y. Electric Equipment Co., 275 Fifth Ave.—How to Light a Library.


Gardiner 91.

Room of Oriental Fixtures, 275 Fifth Ave., N. Y.

FOURTEENTH ANNUAL CLAMBAKE OF THE AMERICAN ELECTRICAL WORKS, OF PROVIDENCE, R. I.

SIX to four in favor of New York was the score in the great annual base ball game played between New York and Boston at the Haute Rive Club, on the Providence River, on the occasion of the fourteenth annual clambake tendered to the electrical profession by the American Electrical Works, of Providence. The game was hotly contested, (it was 95° in the shade) and Umpire Martin Day of the *Providence Journal*, had a hard time preventing the teams from claiming home runs on each and every occasion. It would be invidious to mention any names. Suffice it to say that both teams developed a knowledge of the sport that would have put professionals to the blush. The batting was of the heavy hitting order, while the fielding was done with rare skill accuracy, although it must be admitted that a large number of shady trees in the vicinity helped the fielders in many instances by making some good stops.

A better day for the clambake could not be imagined, and even though at times most of the boys (we are all boys on such occasions) seemed to be in rather a melting mood, yet that might be attributed to the unwonted exercise in which they indulged, and the feeling of good-fellowship which prevailed.

Mr. Phillips has always something new with which to surprise his guests. This year it took the form of a large straw sun hat about 18 inches in diameter, and it required only a few minutes to equip each and every one with one of these Wild Western sombreros. They certainly were welcome in the hot sun, and made the scene very bright and interesting. The usual games at football, baseball, shooting and all sorts of pranks were indulged in, and thorough justice was also done to the clams and salads, as well as to the punch bowl of generous dimensions, which, like the widow's cruse of oil, never seemed to run down. It may be well to state here that it was the general opinion that the punch had never been excelled.

About 3 o'clock the clam dinner was served, over 200 people seating themselves at the tables under the marquee, and enjoying the hospitality of Mr. Eugene Phillips, who occupied a position near the centre with Governor Brown on his right hand, and Mr. Charles W. Price, of *The Electrical Review*, who acted as toastmaster of the occasion, on his left hand. After the clams had all been devoured, and they never seemed to taste better, Mr. Phillips in a short speech welcomed all present. Governor Brown then made a few remarks, followed by a short and pithy speech from Judge McLeary of San Antonio, Texas. Mr. S. G. Stiness of Pawtucket, then replied to the toast of Rhode Island, and spoke in eloquent terms of the little State where the succulent clam finds its home, being followed by Mr. Martin Day, of the *Providence Journal*, who responded to the toast of the press, Mr. Price announcing that the members of the electrical press present were all "too full for utterance,"—their hearts, it is to be presumed. Mr. C. R. Huntley spoke in fitting terms of the National Electric Light Association, and proved to be an orator of no mean degree. Mr. Charles W. Hagar, of Montreal, followed with a few well-chosen remarks, and the exercises were brought to a close by a speech from General Embler, who presented Mr. Eugene Phillips with a handsome full-size portait of himself, in the name of Mr. George Phillips of Norwich, Conn., who was too modest to make the presentation himself. Mr. Phillips acknowledged the gift in a few words. After singing "Auld Lang Syne," the guests departed well pleased with their day, and all promising to be there again next year. A list of the gentlemen present will be found below:

W. C. Fish. Robt. C. Breck, E. R. Tilton, C. O. Baker, C. W. Price, A. A. Ziegler, C. D. Morss, C. B. Burleigh, E. F. Peck, G. P. Hart, S. L. Miller, H. B. Cutler, C. E. Bibber, C. H. McIntire, T. H. Bibber, D. Chalmers, J. A. Cooney, J. A. Carney, A. G. Oakley, W. H. Clewley, Roland Wesser, Romaine Macé, C. B. Price, C. A. Clark, W. E. Tanner, Edw. Caldwell, E. M. Carhart, A. R. Raymond, G. G. Grush, S. Young, G. E. Calef, C. L. Abell, W. S. Key, M. W. Mead, Wm. Martin, H. M. Ballard, T. R. Taltavall, E. E. Wood, L. H. Hart, J. O. Darling, J. A. Jenney, C. R. Huntley, James Brown, A. E. Jenney, D. A. Patten, E. P. Morris, M. W. Brown, A. D. Smith, J. H. McLeary, E. S. Hylan, C. J. Glidder, Gerritt Smith, G. H. Darling, F. Pearie, G. S. Hamilton, L. S. Urquhart, L. S. Dumoulin, Augustus Wright, W. T. Hunt, G. F. Porter, F. C. Mason, J. C. Pierrez, B. F. Hamilton, E. R. Phillips, H. C. Langstaff, S. L. Thurston, E. C. Hughes, A. D. Sayward, W. T. Thurston, Martin C. Day. A. M. Young, A. O. Shepardson, Sam. Hurlburt, J. W. White, H. G. Wright, C. A. White, G. E. Andrews, Jos. Taylor, H. E. Monk, J. H. Learned, D. C. Whitney, D. P. Colton, G. D. Johnson, H. B. Cram, W. H. Austin, P. Fahey, G. H. Thurston, A. C. Shaw, W. K. Wagner, C. W. Card, A. Coleman, W. R. Thurman, F. E. Johnson, J. B. Tatein, H. J. Lockrow, Chas. Sylvester, Robt. Fessenden, W. H. Sawyer, P. C. Ackerman, S. S. Stiness, H. P. Crowley, H. H. Sherman, Levi Sprague, W. N. Hodges, C. H. Bullock, Orin Smith, Jr., W. W. Dempster, C. L. Ring, H. F. Woods, C. L. Bly, G. Clarke, F. A. Swan, D. A. Harrington, H. H. Fairbanks, W. H. Coughlin, W. S. Townsend, Dudley Farrand, S. B. Condes, C. A. Baldwin, A. T. Baldwin, F. D. Hotchkiss, George Wilmot, M. P. Burbank, W. R. Watters, J. H. Studley, Jr., G. H. Buckminster, Capt. A. De Khotinsky, C. W. Wolcott, G. R. Austin, W. J. Hazels, F. J. Boynton, S. A. Richardson, R. W. Smith, H. R. Rice, W. S. Hill, R. F. Capwell, A. H Embler, G. H. Dresser, E. B. Barker, W. H. Babcock, F. M. Kimball, J. B Pearce, R. A. S. Brock, I. O. Wright, N. B. Denison, J. E. Andrews, E. N. Clarke, W. A. McKenney, J. A. McCoy, J. M. Magoon, C. W. Russell, W. F. Whittemore, R. F. Ross, V. A. Thomas, S. A. Leedom, C. W. Holtzer, Father McGlynn, N. W. Lillie, Ruel Smith, W. A. Hathaway, C. H. Herrick, J. I. Drake, S. R. Payson, R. H. Whittier, T. W. Lane, Jr., G. W. Phillips, C. W. Hagar, J. Carroll, E. A. Smith, W. D. Wright, Francis Murdock, M. E. Baird, A. C. White, H. C. Bradford, H. M. French, Welles E. Holmes, Chas. A. Balcom, Chas. F. Luther, GOVERNOR D. Russell Brown, E. E. Cary, F. S. Palmer, G. A. Steese, F. H. Gilley, E. A. Chapel, J. H. Clarke, T. Gould, Jr., J. L. Lucas, W. E. Durgin, H. J. Curl, C. G. A. Peterson, J. S. Knowles, W. A. Carey, C. R. Remington, Jr., B. F. Leavitt, W. N. Munro, C. N. Wood, J. P. Felton, A. B. Field, C. S. Haley, J. P. Loring, W. I Barnes, H. W. Paul.

REVERSAL OF POLARITY IN PLATING DYNAMOS.[1]

BY HARRIS J. RYAN.

SHUNT machines used for copper-plating carbons are frequently found to have their polarity reversed after being stopped. The cause can be ascribed only to voltaic action of the unplated or partially plated carbons, copper anodes, and the plating solution. Any electromotive forces in the bath that would result from the electrolytic action of the dynamo current must be counter to the E. M. F. of the dynamo. Any current that these counter E. M. F.'s might set up through the dynamo when at rest, as is well known, could tend to only maintain the same polarity.

To determine the extent of the voltaic action, Messrs. Thayer and Warner, of the senior class in electrical engineering at Cornell, made a copper plating bath of the density that is found to do best for copper voltameter work. This solution was increased 20 per cent. by the addition of commercial sulphuric acid so as to obtain a solution practically the same as that used by the carbon platers for good tough deposits.

Time.	Volts.	Remarks.
11:20	— .170	Carbon unplated,
11:20½	— .004	Current on 30 seconds. Lower part of carbon plated; plating on the upper part scarcely perceptible.
11:28	— .012	
11:30	— .138	
11:32	+ .085	Current on 1 minute. Well-marked deposit on carbon.
11:34	.000	
11:36	— .002	
11:40	— .064	
11:48	— .130	
11:50	+ .064	Current on 5 seconds.
11:52	— .124	
12:15	+ .138	Current on 13 minutes.
12:20	+ .064	
12:36	+ .053	
12:55	+ .021	
1:45	+ .006	

+ Indicates a counter E. M. F.
— Indicates a voltaic E. M. F.

The table explains itself, and shows that the difference of potential between the unplated carbon and copper is .17 of a volt. After the deposit of a thin film of copper on the carbon this E. M. F., which immediately after stopping the current, was .004 volt, was raised so that at the end of ten minutes it was .138 volt. When a marked deposit was made by the application of the electrolytic current for one minute the cell gave a counter E. M. F. of .085 of a volt immediately on stopping the current. The return of the voltaic E. M. F. was evident, for two minutes later the E. M. F. of the cell was zero, and sixteen minutes from the time of stopping the current the voltaic E. M. F. of the cell was .130 of a volt. At this point the application of the current for but five seconds produced a momentary return of the counter E. M. F. of the cell. Even after the carbons had been well plated by the application of the electrolytic current for fifteen minutes, when the counter E. M. F. of the cell at the moment of breaking the circuit was .138 volt, there was a strong tendency manifested for the return of the voltaic E. M. F.

It is seen, therefore, that with a shunt electroplating machine at work on a bath for plating carbons there is danger of reversing its magnetism whenever it is stopped before the carbons are well coated. It may be avoided by breaking the main circuit before shutting down, and making it again only after the machine has been brought to full speed. This method would generally require the use of a large and expensive knife switch. Breaking and making the field circuit in the same manner would do just as well.

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[1] A paper read at the general meeting of the American Institute of Electrical Engineers, Chicago, Ill., June 6, 7, and 8.

THE BLOCK SIGNALS OF THE PRESENT, AND WHAT IS REQUIRED FOR THE FUTURE.[1]

BY J. B. STEWART.

A GREAT deal has been written on this subject during the past year. Railroad officers have given more attention to it than ever before, and the American Railway Association (formerly called the General Time Convention) has appointed a committee to consider and recommend a standard block signal system, involving, as it does, the very safeguard to the reputation of any railroad that attempts to meet the demands of the traveling public for high speed and safe transportation.

The English or Sykes system is the one now generally in use. Does it meet the requirements and give the necessary security? To answer this question let us first give briefly the method of protecting trains by this system. Each office is supplied with a semaphore signal; the lever controlling the arm is locked. An operator desiring to give a signal to an approaching train must ask the operator in advance to unlock his lever. The signals between block stations are given by bell code on some roads, and on others, where the locking arrangement is not used, by the regular Morse code. As soon as the train passes into the next block the operator places his signal to indicate danger, the lever being again locked. He then signals the operator in the rear that the train has passed out of the block. On crowded roadways, and especially where trains are "closing up" on approaching the great terminal points, these signals must be given instantly, so as to not detain the following train. Herein lies a very great danger. The high speed of our fast freight trains and the distance covered by such trains after the breaks have been applied for an emergency stop will, I think, convince all of you that we are surely and rapidly advancing to the high limit now set and that our block signals have not kept pace with it.

The author then showed the weak points existing in the signaling methods at present in vogue and continued: If we then conclude that the present systems must be improved to insure absolute safety, what will be the system of the future?

Will it be entirely automatic, by means of the rail circuits?

Will it be electro-pneumatic with an attachment to the last car, or will it be, as a writer in the *Railway Equipment Guide* for April suggests, "A system that will display signals continuously throughout each block, so that the signal to proceed or stop will always be in view of the engineer?" This idea strikes me very favorably. With such a system the operator controls the line of signals for a certain distance in the blocks each side of his station. In any event, it is my opinion that electricity will play an important part in the block signal of the future, and as the superintendent of telegraph, or division operator, is the man to whom electrical matters are entrusted, I venture to bring the matter before the members of this association, that we may keep in advance of the movement, and in the hope that some one of you will be fortunate enough to devise the system that will meet all the conditions.

My own experience and observations have led me to believe that a combination automatic and manual will meet the requirements, and, I would suggest, that the blocks be not less than three-quarters of a mile—the home signal operated by a lever, and signals operated by electricity, and gravity or air pressure placed 1,000 or 1,500 feet apart throughout the block, the circuit connecting these signals to be also connected with the lever at the home station, so that in moving the lever to place the home signal at danger the circuit will be opened and the signals go to danger by gravity, or weight; these signals will give ample notice of the position of the home signal and protect a train stopping just beyond a block station—it also admits of giving notice to the train should the block ahead clear after the train passes the distant signal and schedule speed may be resumed before the train reaches the home station.

To eliminate the chance of an operator unlocking the lever while any part of the train is in the block I would add to the above the connecting and insulating of one line of rails throughout each block, this rail to be free from contact with cinder ballast; stone ballast gives best results, running taps from this rail circuit to one side of the metallic line circuit which is used to unlock the lever at the office in the rear.

A train passing over the block will ground the side of the circuit connected by taps to rail; close the relay and the local of this relay will lock the lever which operates the home signal, open the circuit of the block in rear and will remain so till the last pair of wheels connected by a metal axle passes out of the block. With this arrangement it will not be essential that the operator sees the "markers."

There will, of course, be objections raised by railroad officers to depending upon electricity, and their past experience may justify them in doing so, but I believe that it *can* be depended upon, and in my opinion the day is not far distant when it will be. All failures can, undoubtedly, be traced to defective designs or instruments, failure through inattention to the batteries, or, perhaps, all together. We have track circuits, both open and closed; also electric signal circuits, normally closed, and I require that a closed circuit battery be renewed every fourteenth day, no matter what its conditions may be, new zincs placed in the track battery and using the cleaned zincs in the local circuit.

With this systematic way of handling the batteries and reliable men to do the work, and to watch the circuits, there will be no failures of the electrical parts. We have been experimenting with the Beatty zinc on our track circuits with very good results. The zinc is self-cleaning and always presents a clean surface, and, if the solution be kept at a proper strength a uniform current is given out so that changing the adjustment of relays is unnecessary. We are also trying them on normally open circuits, and expect to use them to replace Leclanché cells with gravity, as they do not run out if short-circuited. The first cost of the Beatty zinc is a little more, but a less number of cells are required and the zinc does its work until nothing is left but the stem. Since we arrived here our attention has been called to a new battery, which, if further tests prove as satisfactory as those already made, the zinc will no longer be needed and a long step taken towards the ideal gravity battery.

With a good and reliable battery I believe that electric signals and highway crossing bells will come more generally into use, and, by requiring strict attention from men in charge, our officers will soon lose their distrust of electrical appliances, and recognize in them very useful and economical adjuncts to the service.

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[1] Abstract of a paper read at the meeting of the Railway Telegraph Superintendents, Denver, Col., June 16, 1892.

VARIATIONS OF E. M. F. OF SECONDARY BATTERIES.[1]

FOR some years there has been quite an exciting controversy going on as to the cause of the variations of electromotive force at different stages of charge or discharge. Some say that the resistance of the cell varies; others say that this is the case, but that it varies in the wrong way to account for the phenomena. A fully charged cell, for instance, has PbO_2 on one plate and Pb on the other, with strong acid in the pores, and fairly strong acid between the plates, all of which are good conductors. When discharged it has a percentage of $PbSO_4$ in the coatings of both plates, and weak acid in the pores, and these are bad conductors. The resistance must, therefore, be less at full charge, and yet the electromotive force needed to charge a nearly full cell is much higher than that needed when the cell is practically empty. According to Mr. G. H. Robertson, the rise of electromotive force is due to the formation of persulphuric acid and hydrogen peroxide. Mr. Robertson's views were stated very fully in an able lecture before the Society of Arts in December last.

Dr. J. H. Gladstone, F. R. S., and Mr. Walter Hibbert, F. I. C., in their paper on "The Cause of the Changes of Electromotive Force in Secondary Batteries," recently read before the Institution of Electrical Engineers, champion another theory. They maintain that when a cell is freshly charged the coatings are full of strong sulphuric acid, due to the decomposition of the lead sulphate on both plates. It is, of course, well known that a battery gives a higher electromotive force with strong acid. Messrs. Gladstone and Hibbert's paper is really an elaborate argument in favor of this theory, and is fortified strongly with experimental data. No doubt the variation of acid strength will account for some of the variations of pressure, but it hardly seems to explain the whole matter. If the variation of acid alone produced the results, a battery which had stood for a short time after complete discharge—that is to say, after being run down to, say, 1.85 volts—would give the electromotive force due to the strength of acid employed, the acid having diffused till the electrolyte in and outside the coatings had become homogeneous. On charging with a normal current there would be a little extra resistance due to lead sulphate to be overcome, but the resistance would in most cases be so low that the variation of pressure lost over it may be neglected. The back pressure would, however, rise gradually until the points were reached where gas is given off at one or both of the plates. When fully charged the cell would show a high electromotive force, but, after standing some time, this would fall to almost the same value as at starting. On discharging it would fall gradually as the acid in the interstices weakened.

This theory does not explain the very high initial electromotive force of a cell. That may, however, be due to other causes, such as the formation of a layer of gas, which would not interfere with the action of the acid, and thus would not conflict with the theory. Batteries of different makes give very widely different charge and discharge curves; and in studying such a question it is absolutely necessary to avoid considering one cause only. Some cells discharge fairly completely, and then drop suddenly; others fall more gradually. The form of the discharge curve may be largely due to the using up of the available spongy lead and peroxide, as well as to the gradual impoverishment of the electrolyte in the pores of the coatings.

The question is of purely scientific interest, and unless some remedy can be found it does not matter much why a cell needs a high charging pressure, except the knowledge leads to some method of charging at a lower electromotive force.

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[1] *Industries.*

THE AMERICAN TYPE TELEGRAPH.

Printing telegraphs are almost as old as the electric telegraph itself. House, Hughes, Phelps and others followed quickly in the footsteps of Morse, with devices for supplanting the Morse character with the Roman letter. In some countries they almost succeeded, and, to this day, Continental Europe does a large amount of its telegraphing by means of the Hughes printing telegraph. In England the Hughes machine was extensively employed by the old companies and was only abandoned after the telegraph had been absorbed by the government. In this country there was once a "House" telegraph line using that system exclusively and the Western Union Company has for years transmitted press and other telegrams between Boston, New York, Philadelphia, Baltimore and Washington by means of the Phelps improved "motor printer" with success and at a rate of speed far exceeding that of the Morse.

One of the chief objections to the printing telegraphs in the past has been the "form of delivery." All of them printed their messages on a narrow band of paper or "tape." A press dispatch of a few hundred words would be many feet in length and liable to kinks, breaks and entanglement.

Users of the telegraph have always objected to receiving their dispatches on a ribbon and many have refused to accept them by the yard, asserting that filing with safety was impossible, and that portions of messages were frequently lost. As a result, all dispatches received by printing telegraph in Europe are now torn into short lengths and clumsily pasted on ordinary delivery blanks. The tearing and fouling of the tape in the basket of the ordinary "ticker" is familiar to all, often rendering a backward search for some particular item of news, impossible.

The American type telegraph machine has been designed with a view to overcoming these and many other objections to printing telegraphs as they have heretofore existed. By means of this latest device, the delivery is in the form of a printed page, eight inches wide. All the letters, numerals, fractions and other signs necessary to ordinary typewriting are provided.

The receiving instrument is entirely automatic in its action, requiring no skilled operator to watch or adjust it. The transmitter is similar in form, as far as the arrangement of the keys is concerned, to the typewriter, and can be worked by any person familiar with that instrument. The transmitting operator, by means of his keyboard, has full control of the machine at the distant end of the line, and can vary the length of a printed line or the space between two items of news or two telegrams, at will.

Electrically, this instrument has been designed with the object of relieving the electromagnets, which are operated or connected with the main line, of as much work as possible. This object is accomplished by the use of a suitable motive power (a small electric motor) independent of the magnets, for effecting the mechanical operation of the several parts of the printing and feed mechanisms, and by utilizing the electromagnets merely for releasing, arresting and generally for controlling the action of this motive power.

The type-wheel employed has four rows of characters, and is combined with means for raising or lowering the same for the proper alignment of any one of the rows. An oscillating movement is also given to the type-wheel whereby any desired character is printed on the paper. Mechanism is provided for rotating the type-wheel to present any desired character of a given row to the paper in the printing position; also for moving the type-wheel and its carriage laterally across the face of the paper and for its return to the starting or initial point, and for feeding the paper upward at the end of each printed line.

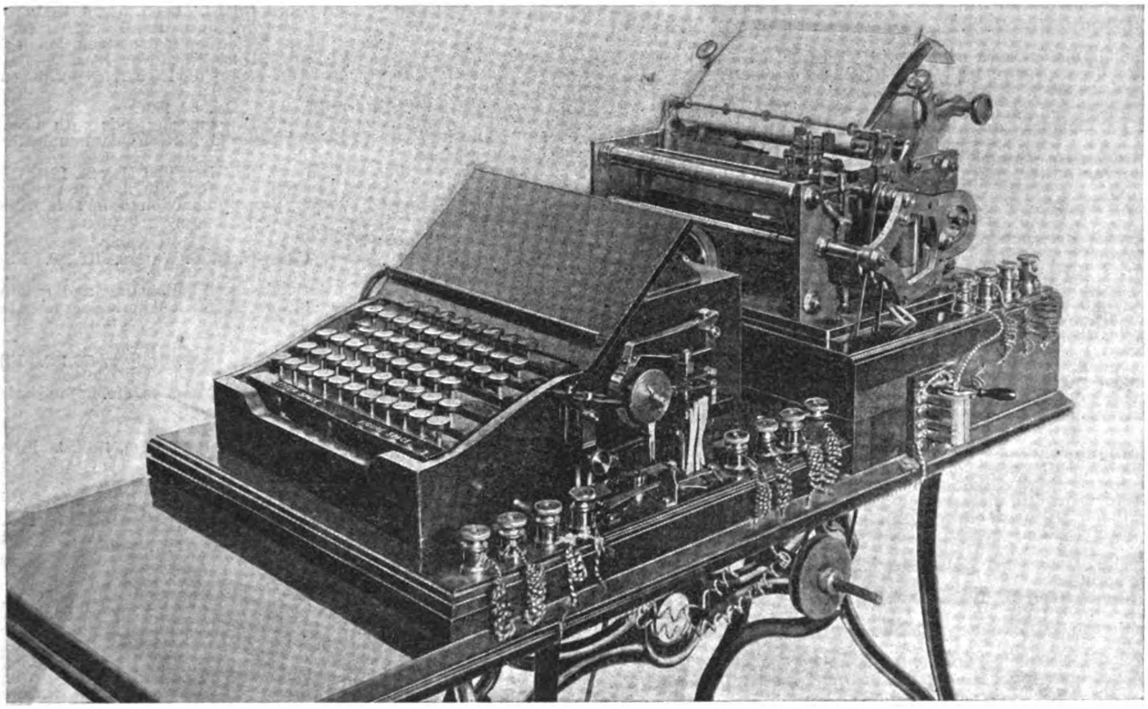
Mechanisms, all actuated by the above-mentioned motor, also set the type-wheel, make the printed impression, control the letter feed and spacing, return the type-wheel carriage and feed the paper. The first, second, third and fourth positions of the type-wheel, presenting the various rows of characters to be printed, are obtained by the action of the motor, as well as the restoration of the wheel from the fourth to its original or first position.

The setting mechanism which governs all of the above movements is a small light shaft actuated frictionally by the motor, and released, step by step, by a sensitive polarized relay in the main line circuit. Here, inertia is small and a consequent high speed of revolution is obtained, four hundred or more revolutions per minute. On this shaft are an escapement wheel, ratchet retaining wheel, unison device and a setting pin and wedge. The moment the pin is placed in the proper position by the action of rapidly reversed currents, other magnets in the circuit, neutral and less sensitive, are affected by the prolongation of the current and release the mechanisms connected with the motor, necessary to perform the various functions already enumerated.

The work done by these magnets, which are in the main line circuit (there are three of them), is of the lightest character possible, and the working of the instrument over long circuits where light currents are necessarily employed, is practically assured. In practice, a speed of over 40 words per minute on a 200-mile circuit, using the ordinary Morse power has been reached, and will probably be exceeded when operators shall have become entirely familiar with the working of the machine.

Typewriting by wire and by ordinary typewriting methods have been the objects sought to be obtained in the American type telegraph. The width of the paper, the form and action of the keyboard, as well as the manipulation of the machine generally, are made to conform, as nearly as possible, to the practice with which an ordinary typewriting operator is familiar.

The accompanying engraving illustrates the machine which has been referred to above. The company are, however, manufacturing another and smaller machine, which also works at a good speed and delivers its matter in the same form, for private line working. In this latter device, the motor is eliminated and the construction is generally simple. A column, or page printing machine, by the same inventor, Mr. J. E. Wright, of New York, has been working successfully in London for the past three years delivering news reports to all the leading newspapers and clubs.



The American Type Telegraph.

Inventors' Record.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JULY 5, 1892.

Accumulators :—

Secondary Battery, J. H. Gerry and C. E. Long, 478,230. Filed Aug. 1, 1891.

Consists of a cell containing shallow compartments separated by insulating partitions and containing active material and lead plates the lower edges of which extend into the active material.

Electric Battery, C. F. Waldron, 478,485. Filed Aug. 22, 1891.

A secondary battery element consisting of a wooden base and a metallic plate presenting a surface of active material in immediate contact with the base; these parts constituting a horizontal tray and remaining in permanent contact without intermediate spacing.

Alarms and Signals :—

Electric Alarm Clock, G. C. Darche, 478,155. Filed June 1, 1891.

Electric Indicator, W. E. Decrow, 478,274. Filed March 8, 1892.

Relates to automatic means for resetting an annunciator after a given lapse of time.

Indicator for Electrical Signaling Systems, C. F. Gillette, 478,324. Filed Aug. 13, 1891.

Provides means whereby the connection between a magneto generator and any desired one of several different points may be readily made.

Conductors, Conduits and Insulators :—

Electric Cable, W. H. Sawyer, 478,367. Filed Feb. 18, 1892.

An electric cable having extremely low electrostatic capacity and great mechanical strength.

Insulator, L. McCarthy, 478,518. Filed April 19, 1892.

An insulator composed of metallic parts separated by interposed compressed sheets of mica.

Distribution :—

System of Electrical Distribution, H. Ward Leonard, 478,844. Filed Nov. 27, 1891.

Consists in maintaining upon each one of three or more conductors a potential different from that in any of the others and connecting the armature terminals of the motor with different pairs of said conductors.

Dynamos and Motors :—

Brush-Holder for Dynamos and Motors, M. H. Hathaway, 478,104. Filed Oct. 8, 1891.

A carbon brush holder of simple construction providing means for compensating for the wear of the brush, and that can be applied to any form of dynamo or motor.

Dynamo-Electric Machine or Motor, E. A. Sperry, 478,142. Filed Nov. 16, 1891.

Relates to special construction of the field magnets, armature cores, windings and insulation for the purpose of cheapening the construction.

Electric Motor, J. B. Secor, 478,475. Filed Jan. 30, 1891.

Employs a base to which all the magnets are magnetically connected and which forms a pole common to all, and a cylindrical field embracing an unwound and non-magnetized armature of magnetic material.

Dynamo-Electric Machine, C. W. Thomas, 478,529. Filed Oct. 21, 1890.

Claim 1 follows:

A duplex commutator of electric currents which consists of a series of long insulated segments alternating with pairs of short segments in two different planes and having dynamometric connection in combination with two pairs of brushes for conversions of a continuous into an alternating current and vice versa.

Lamps and Appurtenances :—

Electric Arc Lamp, E. Thomson, 478,145. Filed March 22, 1890.

Employs an electric motor constantly in operation and a speed-responsive device connecting the carbon with the motor so as to be actuated thereby upon any variation of the speed of the latter.

Incandescent Electric Lamp Socket, H. E. Werline, 478,149. Filed Dec. 22, 1891.

Employs a series of connected resistances composed of carbon filaments and connecting springs.

Electric Lighting System, H. T. Cooke and W. H. Mackay, 478,186. Filed July 17, 1891.

Has for its object to light or extinguish from different points one or more lamps in a circuit.

Suspension Bar for Electric Lamps, T. Dillon. 478,275. Filed April 28, 1892.

Swing Joint for Electric Light Bracket, H. P. Drew, 478,417. Filed May 15, 1892.

Electric Arc Lamp, R. M. Hunter, 478,510. Filed Nov. 12, 1891.

Employs a method of feeding the carbons towards one another at an angle so as to compensate for the inequality in their combustion.

Measurement :—

Electric Measuring Instrument, S. Evershed, 478,097. Filed Dec. 18, 1891.

Has for its object to increase the maximum rotation of the indicator to ninety degrees or more to facilitate the construction of the instrument and to check the oscillations.

Apparatus for the Measurement of Electrical Resistances, S. Evershed, 478,098. Filed Dec. 22. 1891.

An ohmmeter consisting of a current coil surrounding a magnetic needle fixed on an axis supporting a second astatic needle, the coil being supported in a brass frame on which a pressure coil is wound with its magnetic axis at right angles to that of the current coil.

Time-Registering Apparatus for Electricity, H. H. Pattee, 478,237. Filed Dec. 11, 1891.

Relates to means whereby the time during which a current is traversing a given circuit may be accurately and automatically registered.

Metal-Working :—

Electrical Brazing Device, W. Mitchell, 478,201. Filed Aug. 17, 1891.

Consists of a holder for the article to be brazed, forming one electrode of the circuit and a movable pencil forming the other electrode.

Solder for Aluminum, J. W. Richards, 478,238. Filed Oct. 5, 1891.

A solder consisting of an alloy of aluminum, zinc and phosphor tin,

Miscellaneous :—

Prospecting Drill, A. Ball, 478,077. Filed Dec. 31, 1891.

An electric drill for mining purposes.

Electrical Distribution for Cars, S. Young, Morris Moskowitz, L. D. Adler and J. Loewenberg, 478,182, Filed Oct. 15, 1891.

Employs an air compressor driven by one of the car axles and in turn driving an air engine, which latter drives a dynamo generating electricity for light or heating purposes.

Electric Car Lighting System, S. Young and M. Moskowitz, 478,182. Filed Jan. 13, 1892.

Similar to 478,182.

Illuminated Advertising Sign, C. R. McGimsey, 478,204. Filed June 2, 1891.

Operating Submarine Guns, H. Berdan, 478,215. Filed Mar. 22, 1892.

A hydraulic buffer for a torpedo boat, to the rear end of which is connected a contact-making device adapted to discharge the torpedo when the buffer is forced backward by contact with an enemy's ship.

Magnetic Lock, H. V. Smith. 478,245. Filed Dec. 18, 1891.

Rheostat, W. P. Eayrs, 478,276. Filed Aug. 3, 1891.

Employs two resistances having two sets of contacts connected respectively with them, corresponding contacts in each set being connected with their respective resistances at similar points, said resistances being respectively always in contact with the legs of a main circuit, the contacts being movable and adapted to be brought in pairs in contact with the legs of a local circuit.

Voltaic Glove, F. Simpson, 478,293. Filed Mar. 25, 1892.

Employs elements of copper and zinc, which, when brought into contact with the flesh are intended to produce currents of electricity.

Lightning Arrester, C. S. Van Nuis, 478,383. Filed Sept. 16, 1891.

Employs sections of fusible wire in series, the meeting ends being separated by a short space.

Gas Lighting Device, D. J. Quinn and P. W. Hoffmann, 478,522. Filed Nov. 27, 1891.

Railways and Appliances :—

Electric Mine Car, E. A. Sperry, 478,138. Filed Feb. 16, 1891.

Relates to means of transmitting power from the motor to the traction wheels of mine cars while permitting the flection of the trucks from alignment with the frame.

Electric Locomotive, E. A. Sperry. 478,139. Filed April 8. 1891.

Relates to electric supports and driving connections between the motor and the car axle.

Trolley-Wire Splice, E. A. Sperry, 478,140. Filed April 18, 1892.

Claim 1 follows:

A combination of a trolley wire, splice on such trolley wire, tapering clamps each side of splice and a metallic connection between such clamps.

Electric Railway Conduit, M. Shoemaker, 478,175. Filed May 25, 1891.

Employs a metal tube set upon glass insulators and having a blast of hot air constantly forced through it for the purpose of keeping it perfectly dry and preventing the escape of the current from the conductor which is laid upon it.

Electric Locomotive, S. H. Short, 478,242. Filed Nov. 6. 1890.

Relates to the placing of the armature axially with reference to the driving axle and making but one revolution to one revolution of the latter.

Electric Railway, F. Mansfield, 478,846. Filed Nov. 18, 1890.

Relates to improvements in the pickup device carried by the car in a conduit system.

Trolley, J. W. Davis, 478,410. Filed Oct. 22, 1891.

Consists of an elongated body having tapering ends with a central groove and spiral grooves about the papered portions communicating with the central grooves.

Electric Locomotive, S. H. Short, 478,477. Filed May 26, 1891.

Has for its object to combine a motor with axle of the street car and transmit a practically constan propelling action to the axle without the use of the earth.

Switches and Cut-Outs :—

Time Switch for Electric Circuits, B. E. Waters, 478,180. Filed June 11, 1891.

Employs a movable contact maker and supporting and guiding slide bar provided with engaging projections and pivoted spring-actuated levers whose arms co-operate with the projections.

Telegraphs:—

Device for Reproducing Characters, H. C. Bridger, 478,152. Filed Aug. 10, 1891.

A device for reproducing messages, drawings, etc. in fac-simile at distant points.

Telephones and Apparatus :—

Microtelephonic Apparatus for Divers, R. Wreden, 478,493. Filed March 28, 1890.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JULY 12, 1892.

Accumulators :—

Electrode for Storage Batteries, H. Tudor, 378,661. Filed May 30, 1891.

Consists of a core composed of one or more metal bodies having main ribs provided with secondary ribs forming between them grooves and having active substance imbedded in said groove.

Electrode, A. Vanden Kerckhove, 478,661. Filed Feb. 12. 1892.

Consists of a grating and electrodes each secured to the grating by solder on one of its sides and by lugs on the other sides thus leaving a space on three sides for expansion and contraction.

Alarms and Signals :—

Thermal Alarm, H. F. Maxim and J. M. Price, 478,701. Filed Jan. 7, 1891.

Employs a mercury column which closes certain contacts corresponding with varied degrees of heat.

Electrical Thermostat, W. L. Denio, 478,788. Filed Dec. 8, 1891.

Employs a fusible solder having a predetermined melting point.

Electric Signaling Apparatus, W. L. Denio, 478,789. Filed Dec. 8, 1891.

A fire-alarm signal system comprising two main circuits one leading from a central station to the building to be protected and the other to the fire department.

Electric Time Alarm, J. Jacobi, 478,865. Filed Nov. 17, 1891.

Distribution :—

Distribution of Electric Currents, E. Thomson, 478,722. Filed Dec. 6. 1886.

Provides an automatic cut-off in case of accidental short-circuit either in the coils of the generating apparatus or upon the local wires.

Dynamos and Motors:—

Electric Locomotive, J. Gray, 478,591. Filed June 12, 1891.

Has for its object to provide means for increasing the traction between the locomotive and the truck when desired.

Electric Motor, H. F. Ong, 478,968. Filed April 4, 1891.

Employs a field magnet formed of a number of sections corresponding with those of the armature and a multiple switch for sending the current through one or more of the field magnet sections in either direction.

Metal Working :—

Method of Welding Metal Wheels, E. H. Scott, 478,643. Filed Jan. 28, 1889.

A method of securing the spokes of metal wheels to the felloes by welding them together by electricity.

Method of Making Metal Wheels, E. H. Scott, 478,644. Filed Jan. 28, 1889.

Similar to 478,643.

Miscellaneous :—

Magnetic Separator, C. M. Ball, S. Morton, 478,551. Filed Oct. 12, 1891.

Apparatus for Lighting Locomotive Engines, A. R. Cavner, 478,683. Filed August 1, 1891.

An electric head light for locomotives.

Mold for Glass Battery Jars, J. Gayner, 478,792. Filed Nov. 9, 1891.

Electro-Mechanical Apparatus for Starting or Reversing Machinery, A Piat, 478,816. Filed Apr. 2, 1890.

Claim 2 follows:

In machines actuated by an electric motor the combination with the lever for controlling the current and the motor, of a contact arranged on the under side of said lever, fixed contacts on each side of the lever and in the path of the first contact, hinged levers and springs whereby a movement of the lever will cause said contact to move under and raise one of said hinges until the contact shall have been passed and a reverse movement of the lever will cause it to travel above the contact.

Electric Elevator, A. B. See & Walter L. Tyler, 478,821. Filed March 14, 1892.

Relates especially to electrical devices for stopping and starting elevators.

Railways and Appliances :—

Electric Rail Bond, T. J. McTighe, 478,629. Filed Apr. 1, 1892.

A rail bond having shoulders and rivets all in one piece.

Conduit System for Electric Railways. W. H. Ford, 478,956. Filed July 6, 1891.

Employs a main insulated conductor, a sectional bare conductor composed of one long and two short sections alternately, suitable connections between the main and sectional conductors and switches between the same under the control of the moving vehicle.

Switches and Cut-Outs :—

Cut-Out Switch, W. E. Cleveland, 478,689. Filed Sept. 21, 1891.

A combination of cut-out switch and fuse, the latter connected with the contacts and being supported away from the switch lever.

Arc Extinguisher for Electric Switches, S. H. Short, 478,718. Filed Mar. 10, 1891.

Employs a series of supplemental contacts in the path of the switch lever, each being a good conductor of heat and electricity.

Telephones and Apparatus :—

Desk Attachment for Telephones, L. C. Butler, 478,564. Filed Sept. 9, 1891.

Telephone, P. H. D'Unger, 478,692. Filed Mar. 29, 1892.

Claim:

The combination in a telephone of the diaphragm and arm projecting over the diaphragm, a screw in said arm and a buffer actuated by said screw and adapted to bear against the diaphragm.

Telephone Repeater, T. A. Edison, 478,743. Filed Oct. 14, 1885.

Claim 1 follows:

The combination with the telephone line of two or more reciprocal telephone repeaters connected therewith, each repeater comprising a receiving and transmitting telephone.

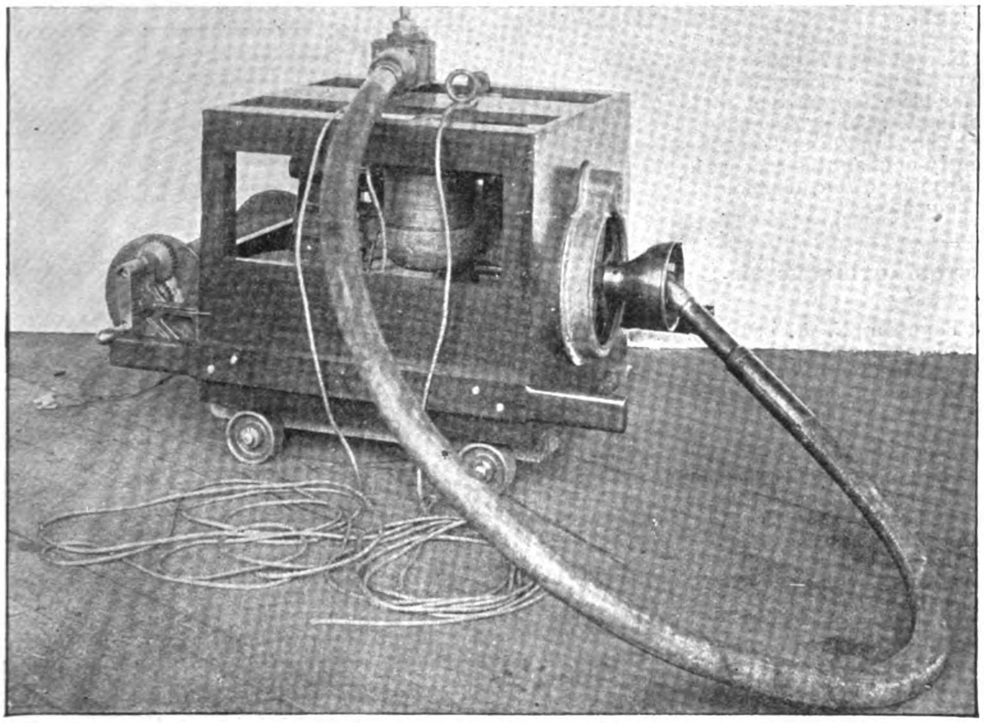


FIG. 2.—BILLBERG PORTABLE MOTOR.

THE GLASGOW UNDERGROUND RAILWAY, the contract price of which was over $5,000,000 is nearly finished. It was begun nearly three years ago and is seven and a quarter miles in length.

BILLBERG PORTABLE MOTORS.

THE accompanying cuts, Figs. 1 and 2, represent a Billberg portable motor for driving drill presses, portable reaming machines, etc., where the power is a long distance from the work. The frame of the motor is of wrought iron, to combine the most power with the least weight. The bearings are all self-oiling, of the sleeve type, and can be easily replaced. The motors are first class in construction and have improved armature commutators and self-feeding brushes.

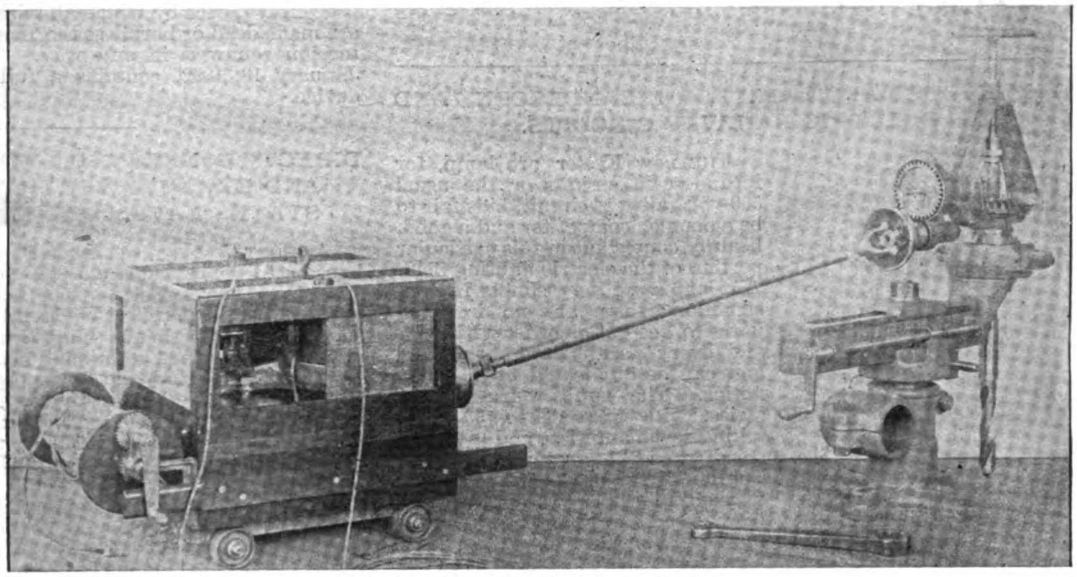


FIG. 1.—BILLBERG PORTABLE MOTOR.

The motor is furnished with a switch and rheostat for changing the speed, and also reducing gearing so that the spindle for attatching the connection shaft can be run at 250 and 500 revolutions and eight intermediate speeds. It is fastened upon the box containing the rheostat and is covered with a wooden top with wire cloth which protects it from injury and at the same time allows a free circulation of air.

To one end of the box is attached a reel containing 100 feet of flexible connection, which will allow of the motor being used anywhere within this distance from the connection box. The motor box is mounted on wheels so that it can be rolled when at work and also has wooden batten handles so that it can be carried. These machines are made of two sizes, at present; the 2 h. p. weighing complete 275 lbs—boxed for shipment 350 lbs; the 3 h. p. size weighs complete 375 lbs.—boxed for shipment 500 lbs. Fig. 1 represents one of the motors coupled by a telescope shaft to a Dallett special portable drill.

Since the Billberg motors were brought out about two years ago they have become very popular and have given entire satisfaction. Among some of the many concerns using these motors are the Franklin Sugar Refinery, William Sellers & Co., Phila.; Sotter Bros. Pottstown; Edgemoor Iron Works, Edgemoor; De La Vergne Refrigerating Co.; New York Central R. R., and Brooklyn Navy Yard, New York; Norfolk Navy Yard, etc. These special motors, as well as a standard line of motors, generators and dynamos are manufactured by Thos. H. Dallett & Co., York street and Sedgeley avenue, Philadelphia, Pa.

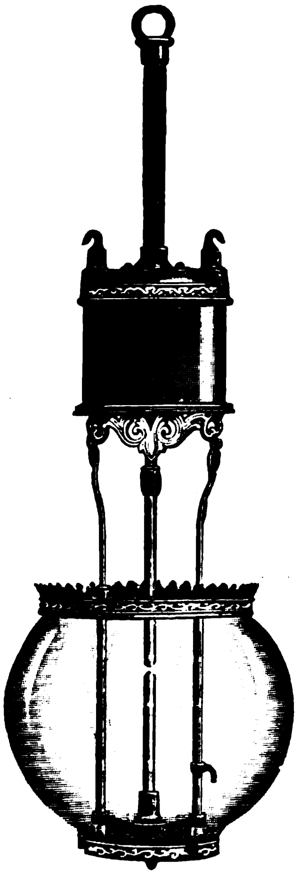
THE PENNSYLVANIA'S electric railway system, extending from Jersey City to the adjacent towns, is under active discussion. With the exception of the usual fossils, New Jersey residents are quick to see the advantages of the proposed system.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

In this wideawake age advertising is absolutely essential.

THE KESTER ARC LAMP FOR INCANDESCENT AND ELECTRIC RAILWAY CIRCUITS.



Kester Arc Lamp.

The new Kester arc lamp, for incandescent circuits or the usual 500-volt railway circuit, bids fair to be a popular competitor and a good, healthy contestant in this particular portion of the electric lighting field. The lamps are very simple in construction; there are no intricate parts to get out of order whatever, and every part is interchangeable and can be duplicated on shortest notice. The lamps burn two in series, with from 100 to 150 volts, taking seven amperes, and giving a steady arc at 3½ amperes per lamp. The lamps for use on electric railway circuits burn four in series on from 220 to 500 volts. There are four especial features in the lamp worthy of particular attention, viz., positive clutch, single armature, clutch-releasing device and lifting spring. These devices are all mounted on one frame and practically make up the entire working parts of the lamp.

The company is not an old one, but although only recently organized, is already in receipt of some desirable orders and is anxious to locate a limited number of desirable agencies. Mr. J. F. Kester, the president and general manager, has had excellent experience in Terre Haute, Ind., where he was the active head and electrician of the Kester Electric Co., whose products are well known. A large factory, with excellent facilities, is located at 173 South Canal street, Chicago, whence lamps are being shipped to all parts of the country in quantities that are highly gratifying to the stockholders of the company.

A SUCCESSFUL TEST OF THE JOHNSTON AUTOMATIC DISCONNECTOR.

A very interesting test was made at Paterson, N. J., on the afternoon of July 18, of the Johnston safe automatic-electric disconnector as applied to trolley wires, under the direction of Mr. Wm. A. Cullen, superintendent of line construction for the Paterson Railway Company, and Mr. F. B. Jacobs, secretary of the Johnston Company, in association with Colonel Rice.

A No. 0 B. & S. gauge trolley wire was strung along East 33d street a little over 500 feet in length. The disconnectors were cut into this line, with about 250 feet of wire between them and a trifle over 125 feet on each end, the wire being drawn up to the usual tautness and so subject to the same strain as usual. Connections were made to the feeder wire which was supplying current to the cars on the Cedar Lawn Division near by, and taps were made at the top or centre of each disconnector.

All then being in readiness Mr. Cullen, to show those assembled that there was current on the wire, made a momentary contact with the track with a light wire; a flash resulted, satisfying every one that the wires were alive. Word was then given to a lineman, who was stationed on top of a tower wagon near the middle of the centre span, to cut the wire, which he did, allowing both ends of the wire to drop to the ground. Though every one watched to see a flash or the wire burn off, they were disappointed, as the wires were perfectly harmless, the current being completely cut off at each disconnector. Not fully satisfied with one trial Mr. Cullen ordered the wires restrung, which being done, they were cut a second time, with the same result as before.

Every one went away perfectly convinced that the disconnectors were just the thing for the work. All that was needed was a little strengthening of a few minor mechanical details to make the apparatus perfect. Those who witnessed the test were Mr. E. J. Lawless, manager of the Paterson Railway Co., Mr. M. Ludwig, superintendent of the Edison Electric Illuminating Co. of Paterson; Mr. Geo. G. Rhoderick, secretary of the Cullen & Rhoderick Engineering Co.; Mr. Jas A. Heagon, of the Paterson Railway Co., and a score of others. The "Disconnector," as its name implies, is a safety device by which all wires in which it may be placed are made dead or harmless the moment they are broken or the tension removed in any way. The Electrical Engineer of January 13, 1892, contains a full description of this valuable device.

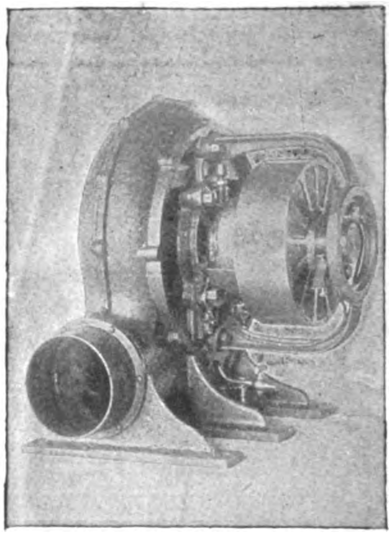
DIRECT CONNECTED WADDELL-ENTZ MOTOR AND EXHAUST VENTILATOR FOR THE UNITED STATES NAVY.

A short time ago the Navy Department called for an air exhauster to be driven by a direct-connected electric motor, which should be so arranged as to be readily detachable. In carrying out the specifications the Waddell-Entz Electric Co., of this city, submitted a design and built a machine which has proved so satisfactory that ten additional motors have been ordered by the Navy Department for the ships now building.

The general design of the combination will be seen in the accompanying engraving. The armature shaft of the motor is prolonged and carries the fan, a single bearing only being employed, which is situated within the core of the hollow field magnet.

The motor is series wound for 80 volts and 3.2 amperes. The resistance of the series field at 15.5 deg. C. is 4.2 ohms and the resistance of the armature 2.5 ohms. During a recent test the motor ran for three hours at 80 volts, taking 1.8 ampere at 1,850 revolutions, with the exhauster wide open, the motor running cool in all its parts. A ¼ h. p. being called for by the Navy Department, the motor was designed for that power, but owing to the high efficiency of the motor, as shown above, the power consumed was very much less. The motor was also tested for about one hour at 110 volts and 3.2 amperes without heating or sparking. The insulation resistance in all tests was 1 megohm on the field and 35,000 ohms on the armature.

The machine is designed so that it may stand on deck independently wherever required. For this purpose the side of the shell is strengthened by a ring, and extra long feet are provided giving a firm base to the combination. In actual service the motor is completely enclosed in a brass shell, so that it can be exposed to the weather at all times without injury. The entire arrangement is most compact, and has called forth high praise from the navy officials.



Direct Connected Waddell-Entz Motor and Exhaust Ventilator.

MANUAL OF TELEGRAPHY.

The Western Electric Company publish, in connection with their April catalogue of telegraph instruments, an excellent telegrapher's manual in condensed form, comprising the Morse code, with explanations and directions for sending and receiving, and numerous exercises intended to test the progress and skill of the beginner. There is also a quantity of useful miscellaneous information and advice to young operators.

THE ROBB-ARMSTRONG ENGINE.

THE accompanying illustrations show a new engine of the single-valve automatic type lately introduced by the Robb Engineering Co. of Amherst, Nova Scotia.

The engine weighs about 100 pounds per horse power, so distributed as to give the greatest attainable stiffness, while the foundation furnishes all the weight required. The frame, as will be seen by referring to Fig. 1, is of the "Porter" type with a double-disc crank particularly thick at the top, thus bringing the metal in the direct line of strains between the cylinder and shaft bearings.

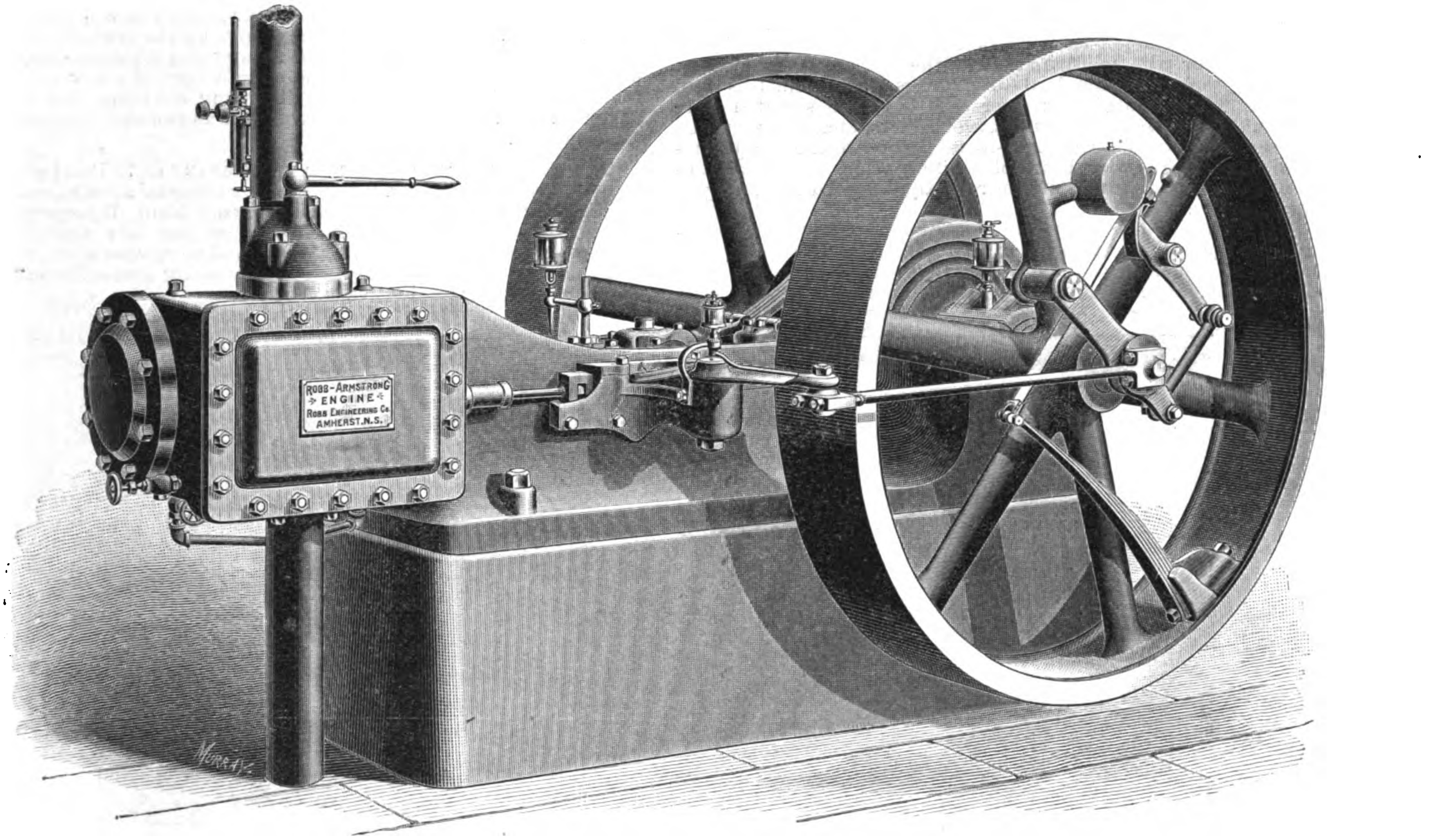

ROBB-ARMSTRONG
ENGINE
ROBB ENGINEERING Co.
AMHERST.N.S.

FIG. 1.—ROBB-ARMSTRONG ENGINE.

The crank is built up of cast discs and the fits of the shaft are very long, as seen in Fig. 2. The bearings are ground with great accuracy and both shaft and shells are made to gauge and are interchangeable. The crank is covered by a cast iron case which is hinged, as shown in Fig. 2, so that free access within may be had at all times.

The crank-pin is oiled through two ½ inch holes, extending from either side of the crank to the centre of the pin, and all oil wasting from the outer ends of shaft bearings is caught, and returned by a ring to the bearing, until it finds its way to the crank-pin and escapes to the crank pit, whence it is drawn off and filtered.

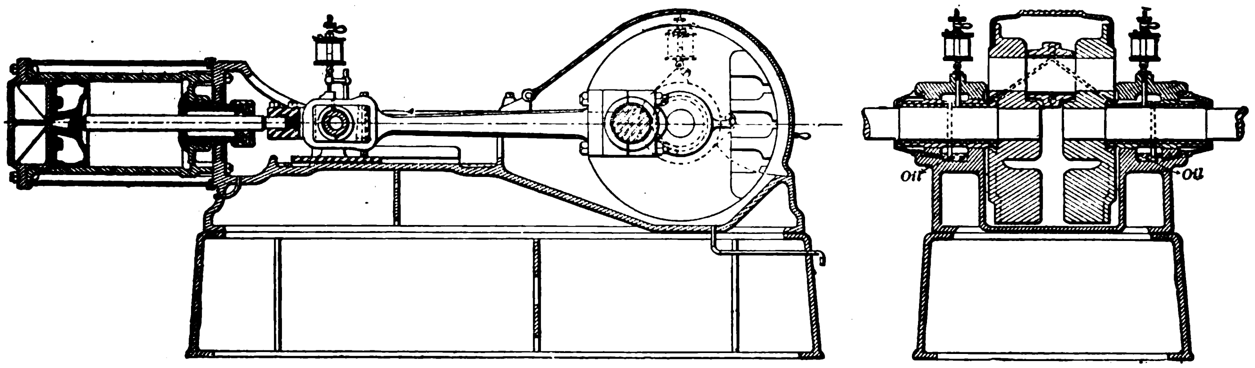


FIG. 2.—ROBB-ARMSTRONG ENGINE.

The fly-wheel governor is a modification of the "Straight Line," and, with the valve and the oiling devices is used by arrangement with the Straight Line Engine Co.

What corresponds to the eccentric rod, although there is no eccentric, has ball-and-socket bearings at each end. The rocker arm is horizontal, and there is no twisting strain on either of its bearings, as a straight line passes through all three of them. An index finger shows the movement of the valve. Oil passes to the eccentric pin through the hollow eccentric rod, and what escapes is caught and held in the flanged fly-wheel.

This engine was designed by Mr. E. J. Armstrong, of the Ames Iron Works, Oswego, N. Y., where it is built in this country.

F. P. LITTLE & CO.

THE above firm of 141 East Seneca Street, Buffalo, N. Y., have just closed a contract for wiring the Lyceum Theatre in Buffalo, for 600 incandescent lights. furnishing all the fixtures, stage regulators, etc., complete. They have also closed a contract for lighting the Woodlawn Beach summer resort, on the south shore of Lake Erie. For this plant they furnish a 30 h. p. locomotive boiler, a 7½ by 12 Rice automatic engine, a 16 kilowatt Thomson-Houston dynamo, 16 Mosher arc lamps and 75 incandescents of 16 c. p., all wired up complete. They furnish all the poles, line wire, etc., put in position, as well as build the foundations for the machines. Both of these jobs have been begun.

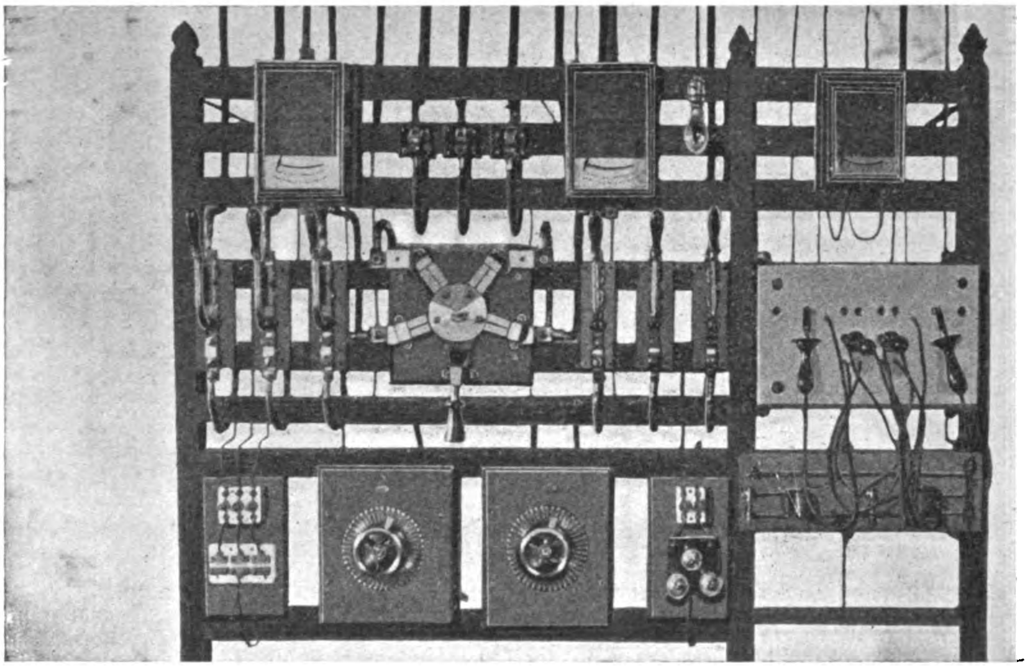
THE GREENVILLE, PA., ELECTRIC LIGHT STATION.

In Greenville, Pa., there has recently been installed by the Edison General Electric Company for the People's Electric Light Company of that town, an electric lighting plant for incandescent and arc lighting. The steam plant consists of two Buckeye compound non-condensing engines each with a capacity of 75 h. p., and an upright Syracuse boiler of 150 h. p.

The electrical equipment comprises two 45 K. W. compound wound Edison standard incandescent dynamos, and one 40-light 2,000 c. p. standard Edison arc dynamo.

The different controlling and measuring instruments are mounted on a skeleton switchboard so constructed that it has only sufficient wood to support the instruments, as seen in the figure. The left-hand portion is devoted to the different appliances for the manipulation of the incandescent system, consisting of the standard regulators, amperemeters and switches. The lightning arrester used is of the serrated plate pattern. The pressure indicators, voltmeters, etc., are mounted on a separate board. The right-hand portion of the board supports an arc light switchboard of white marble, a standard Edison ampere meter andtwo of the recently-designed Edison lightning arresters.

The Edison three-wire system is used, and all customers burning more than six lights are supplied with a three-wire service. Customers burning less than this number of lights have a two-wire service, the lights being carefully arranged against each other so that too much current may not be carried over the neutral wire. The Edison meter system has been adopted, the latest type of electrolytic meter being used. The meter-room is completely equipped in order that this part of the service may be adequately attended to.



Incandescent and Arc Switchboard, Greenville, Pa., Electric Light Station.

The pole line for the incandescent system is about 2,000 feet in length. Where the incandescent and arc systems are common the lines are run on the same poles. In the outlying districts, however, the lighting is done by arc lamps exclusively. The line for the arc system is between four and five miles long.

The dynamos operate so well that they take care of the load with but little adjustment of the field regulators, and the load can be thrown from full to no load without the necessity of altering the resistance in the least.

NEW ENGLAND NOTES.

Swan & Lane, of Boston, have just completed arrangements with the Jenney Electric Motor Company, of Indianapolis, whereby they will act as their agents in this city. The Jenney motor is well and favorably known to the trade, and Swan & Lane will carry a complete line of all sizes in their store at 194 Summer street, for quick shipment. The Jenney Company have recently been making a specialty of installing complete power installations, consisting of generators and motors, for use in factories in connection with lighting plants, and have already installed a number of these plants with complete success.

The Eastern Electrical Supply Company, of Boston.—The controlling interest in this company has just been secured by Messrs. D. A. Andrews, Sr., D. A. Andrews, Jr., and C. B. Price, all of the Pettingell-Andrews Company, of Boston. Mr. Maybin W. Brown will continue as president and Mr. D. A. Andrews, Jr., will hereafter act as treasurer of the company, in addition to his duties with the Pettingell-Andrews Company. The business of the Eastern Company will be conducted for the present from their present quarters, though it is expected that they will remove to 196 Summer street later on in the summer.

The Consolidated Electric Manufacturing Company, of Boston, have given up their Franklin street retail store, and will hereafter do all their business from their factory at 355 Congress street, Boston. They have decided to give up the general electric supply business but will retain the factory and wholesale department, confining themselves to the manufacture of a few specialties, such as the Lyon brake, the Heymann arc lamp, and other novelties. Mr. C. E. Bibber will continue as general manager of the company.

The Boston Incandescent Lamp Company of 70 Pearl street, Boston, has appointed Mr. C. E. Bibber as general sales agent for the United States, of their new incandescent lamp. This company has only been in existence a short time, but has already established a good reputation for its lamps, and is crowded with orders to its utmost capacity. They are now making arrangements to about double their productive capacity.

The Berlin Iron Bridge Co., of East Berlin, Conn., have received the contract for the new tinplate works which Hughes & Patterson are to erect at Philadelphia, Pa. The buildings will be of iron from the designs of the Berlin Co. The main building will be 40 feet wide by 253 feet long with a wing of the same width, 300 feet long, both two stories high. The rolling-mill will be 120 feet wide by 160 feet long, with an annealing room 75 feet wide by 160 feet long. The whole plant will require about 800 tons of iron to be used in its construction.

The Walworth Manufacturing Company, of Boston, have purchased a piece of land in South Boston at 485 Congress street extension, for the purpose of erecting a factory for the manufacture of the steel poles used in electric street railway work. They will also put in this factory a large pipe-bending plant, and other necessary machinery for the manufacture of iron and steel material used in equipping electric railways; in fact these plants will be built expressly in connection with their intention to install, and equip electric railways complete.

The Electric Heat Alarm Company, of Boston, gave an exhibition of their system under the management of Mr. J. P. Robinson, in St. John, N. B., a few days ago which was very successful in every way. The alarm has been perfected in a number of details lately, and the company is now ready to apply their system to factories, hotels and all large buildings, as well as to machine shafting and bearings. It is expected that a local company will be formed in St. John.

CROCKER-WHEELER ELECTRIC CO.

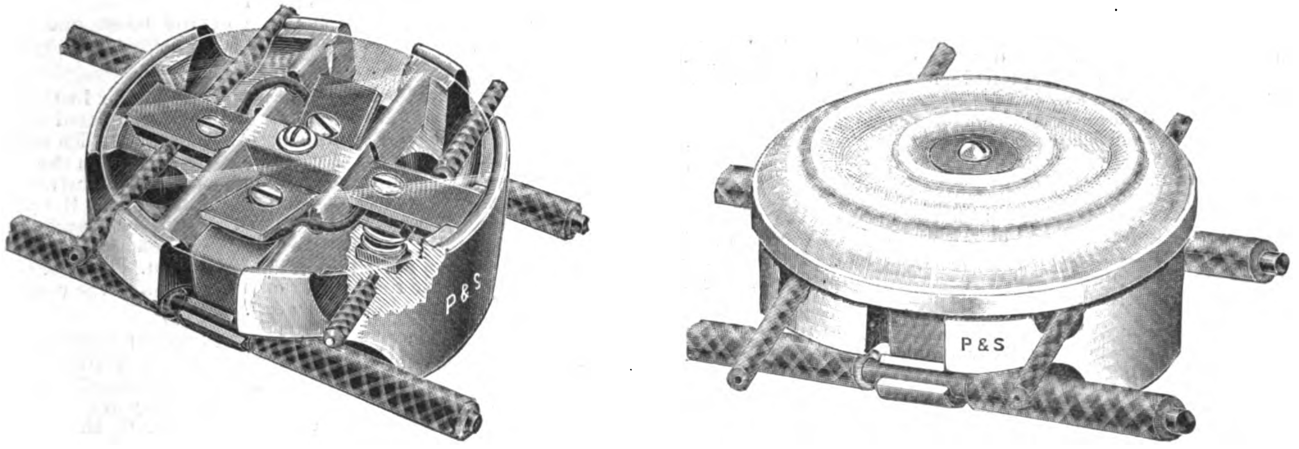
The Crocker-Wheeler Electric Company, New York, have been in operation a little over two years. Last winter they paid a dividend of 5 per cent., and they paid an extra dividend of 3 per cent. July 1, out of the earnings of the company. Their business has increased so rapidly that they were compelled last year to increase their capital stock from $100,000 to $200,000. The new stock was quickly sold for cash at par, all being taken by some of the strongest men in the city. The officers of the company are: President, S. S. Wheeler; vice-president, F. B. Crocker; secretary and treasurer, D. H. Jeffery. The business this year has averaged several times as much as last year, and, notwithstanding their largely increased plant, they have been compelled to run nights to keep up with their orders.

"HONOR TO WHOM HONOR IS DUE."

We are requested by Queen & Co., of Philadelphia, to mention that the cable-testing keys illustrated in our issue of June 29, were suggested to them by E. W. Stevenson, electrician of the Brush Electric Illuminating Co., New York. Mr. Stevenson has had wide experience in such matters, and hence knows well what the actual requirements are. He has used a set of keys similar to those Queen & Co. make, for some time past, with very satisfactory results. In fact, Mr. Stevenson has a number of ingenious ideas in the line of instruments and special measuring apparatus.

THE PASS & SEYMOUR BRANCH BLOCK.

The accompanying illustrations show clearly the construction of the china branch block introduced by Messrs. Pass & Seymour, of Syracuse, N. Y. It is very neat in appearance, and is claimed to entirely overcome any danger of the blowing of fuses from loose connections. It is made in two sizes, with or without a china cover, for 25 and 50 amperes, the former size being but one-fourth inch larger than an ordinary ceiling rosette.



Figs. 1 and 2.—Pass and Seymour Branch Block.

THE AMERICAN GIANT MICA INSULATING JOINT.

The accompanying illustrations show a new insulating joint recently introduced by the Novelty Electric Company of 50 to 54 North Fourth street, Philadelphia.

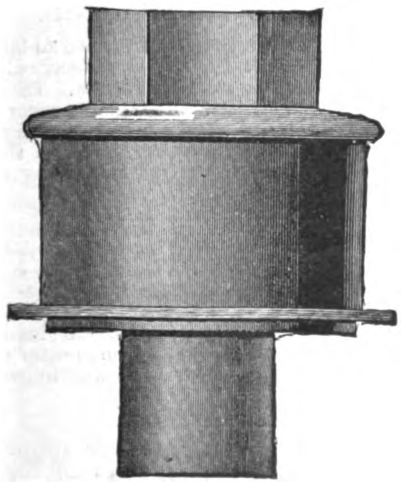


Fig. 1.—American Giant Mica Insulating Joint.

By reference to the sectional illustration, Fig. 2, it will be seen that E E is the main body, D D the upper screw cap, and A A the lower screw cap between which and the body is a heavy mica insulation. B B is a heavy fibre washer, itself a good insulator, upon which rests an iron washer C C into which is firmly screwed the lower cap and stem.

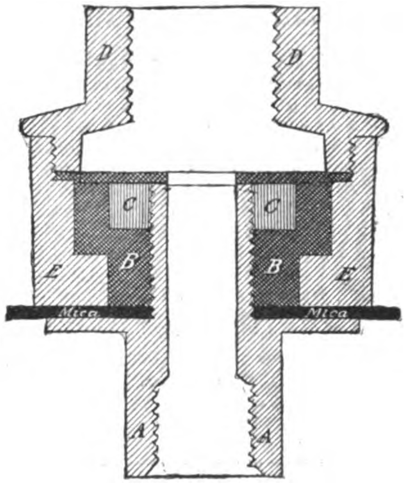


Fig. 2.—American Giant Mica Insulating Joint.

As a further preventive against a possible leakage of gas, the whole body of the joint is filled with cement, poured in hot, covering the head of the iron washer, and filling completely every air space between the washer, B B and body, E E, tightly compressing the mica insulation between the metal parts A A and E E, and forming a perfect gas joint.

An important feature of this joint is the precaution against accident should any defect occur in the insulation. In such a case, if an arc is formed that will burn out the insulation, the heating of the metal softens the cement, which fills in the aperture and effectually closes the leak. This insulating joint has, after repeated tests, been fully endorsed by Mr. William McDevitt, inspector for the Philadelphia Board of Insurance Underwriters.

GROWTH OF THE BALL ENGINE CO.

Less than a year ago, owing to the great expansion of their business, the Ball Engine Co., Erie, Pa., were forced to erect a large and complete machine shop which was filled with the latest and most modern improved tools. No idea was entertained at the time that any further increase would be necessary for several years to come, but the demand for the latest improved Ball engines built by this company has been so great, especially for electric railway work, that already the makers of the engine have been again compelled to make a further extension of the same building. This extension which is now under way will be built on the gallery plan the same as the rest of the building. It will contain, among other valuable features, very complete testing blocks and apparatus, and will be capable of testing engines of the largest capacity. Every engine that leaves the works of the Ball Engine Co. is thoroughly tested and guaranteed to give satisfaction under the most unfavorable circumstances.

Julius Andrae, of Milwaukee, has made arrangements to represent the Central Electric Company in that city.

SALES OF BALL ENGINES.

MR. FRANK R. CHINNOCK, the New York agent of the Ball Engine Co., 15 Cortlandt street, has made the following sales during the past six weeks of the well-known Ball engine, of Erie, Pa.

Prohibition Park Railway Co., Port Richmond, one 150 h. p engine; F. O. Mathiessen, chairman Mfg. Com. Amer. Sugar Refining Co., two 100 h. p. engines for Baltimore; Baltimore Traction Co., Baltimore, Md., two 130 h. p. heavy duty engines; F. H. Leggett & Co., New York City, one 50 h. p. engine; Metropolitan Telephone & Telegraph Co., New York City, one 50 h. p. engine; Brokaw Bros., New York City, two 150 h. p. and one 80 h. p. engine; H. Ward Leonard & Co., New York City, one 150 h. p. engine; Curtis & Dean, New York City, one 50 h. p. engine; Royal Light, Heat and Power Co., Front Royal, one complete steam plant, 100 h. p. engine and 125 h. p. boiler; Hot Springs Electric Co., Hot Springs, Va., one complete steam plant, 100 h. p. engine, and two 80 h. p. boilers; Wm. Kynoch, Guantanamo, Cuba, two 80 h. p. engines; C. S. Furst, Newark Ave., Jersey City, one 50 h. p. engine, one 80 h. p boiler; Navy Yard, Brooklyn, N. Y., two 80 h. p. engines. Mr. Chinnock has also just closed a contract with the Buffalo Board of Trade, Buffalo, N. Y., for one 60 h. p. engine.

NEW YORK NOTES.

THE JOHN A. ROEBLING'S SONS COMPANY have just laid for the United States Port a gutta-percha cable from the Battery to Ellis Island in New York Harbor, the total length of the cable being 9,310 feet. It is composed of four conductors each of three No. 16 B. W. G. copper wires insulated with one-quarter inch gutta-percha. Owing to the constant danger of being fouled by vessels' anchors the cable was armored with eighteen No. 4 galvanized steel wires of very high tensile strength. This gives a strength sufficient to hold any ordinary vessel without damage to the cable. The ten conductor gutta-percha cable laid last year by this company across San Francisco Bay is giving perfect satisfaction. This cable is also very heavily armored with high strength steel wire.

H. DURANT CHEEVER, president and manager of the Okonite Co., Limited, has gone to Europe on a well-earned vacation and generally in the business interests of the company. Mr. Cheever will inspect the European Okonite factories, and besides make a circuit of the continental cities.

PUTNAM, GAY & CO., of Rochester, N. Y., are fitting up the N. Y. State Western House of Refuge for Women at Albion for electric lighting throughout. There are six large separate buildings, and all work is to be done in the tubes of the Interior Conduit Company.

H. WARD LEONARD & CO., of the Electrical Exchange Building, Liberty Street, have closed a contract with Heilner & Strauss, Newark, N. J., owners of the Continental Corset Co., for placing a lighting plant in their new factory.

THE SECURITY INSULATOR is rapidly meeting with the approval of the trade in general, and the Electric Appliance Company of Chicago, who are the general Western agents for this specialty report a very brisk sale.

WESTERN NOTES.

THE ELECTRICAL SUPPLY CO.—The Crocker-Wheeler Electric Company, through their general sales agent, Mr. George W. La Rue, have recently consummated an important arrangement with the Electrical Supply Company, Chicago. By this arrangement the latter firm become sole agents for the Crocker-Wheeler goods in Chicago, and distributing agents for such parts of the Western territory as are covered by their traveling salesmen. Mr. H. C. Hutchison, formerly of the Chicago office of the Edison General Electric Company, is to have charge of the motor department for the Electrical Supply Company, and will be assisted by several well-known motor salesmen and electrical engineers. The popularity of the Crocker-Wheeler goods, and the well-known reputation of the Electrical Supply Company as "pushers" should result in the placing of a large number of these motors and generators on the Western market.

THE CENTRAL ELECTRIC COMPANY are meeting with success with the Acme lead cable manufactured by the Okonite Company. This cable is substantially made, and for underground service, there is none better. It has been on the market now about a year, and no complaints are heard, but rather praises in its favor.

THE ELECTRIC APPLIANCE COMPANY report large success of late with Paranite wire having received very large orders from St. Louis, Milwaukee and St. Paul within the past few weeks in addition to their regular business on Paranite, which has been exceedingly large.

"CUTTER'S RHEOSTATS" are among the coming Western specialties as a nice line of them is now being developed. They will all have the resistance wire buried in enamel, and promise to be safer and much more compact than the resistance boxes now in general use.

CAPTAIN JOHN MCKINLOCK, treasurer of the Western Electrical Supply Company, the Omaha branch of the Central Electric Company, is in the city for a few days.

MR. GEORGE CUTTER is putting out a new version of his magnetic cut-out for protecting stationary motors, and already has several dozen in service.

NEW ENGLAND NOTES.

INSPECTOR OF WIRES B. S. FLANDERS, has, with his usual progressiveness, advanced and recommended the idea of using dynamos for furnishing the current necessary for the operation of the fire alarm system of Boston, in place of the battery, which, in common with other cities, is the present method of supply. The advantages in the use of dynamos in place of batteries are many. One advantage which will be obvious to all who have had experience in such matters, is the small amount of room and little attention which the dynamos will require in comparison with what is necessary for batteries. Inspector Flanders has at the present time a small motor and dynamo set up in his office, which has for several weeks been furnishing current for some of the fire-alarm circuits with perfect success. If the use of dynamos for the fire-alarm system of Boston be adopted, it will be the first installation of the kind in any city for this purpose. It is the intention of Inspector Flanders that in the new fire-alarm station which is to be in the fire department quarters now in process of construction on Bristol street, everything shall be of the latest and most approved pattern, and that Boston shall have a fire-alarm system second to none in the country.

THE SPECIFICATIONS for a 600-light plant for the City Institution on Long Island, Boston Harbor, have just been completed by the Massachusetts Electrical Engineering Company, and bids will be requested from the different electric companies, within the next few days. Such a large number of bids have been received for the 6,000-light plant for the Massachusetts State House, the plans and specifications of which were prepared by the Massachusetts Electrical Engineering Company that it will take considerably more time than was expected to make a decision. The matter is however, being considered by the commission and the contract award will probably be made this week.

THE MASSACHUSETTS ELECTRICAL ENGINEERING COMPANY, of Boston, are at present making the plans and specifications for a 200-light incandescent plant in the mills of the George H. Wheelwright Paper Company, of Hardwick, Mass. They are also making plans and specifications for a 1,200-light plant for the Ipswich Mills, Ipswich, Mass., the specifications for which will be ready in a short time for the bids of the electric companies.

PHILADELPHIA NOTES.

THE AMERICAN GIANT MICA INSULATION of the Novelty Electric Co., 50, 52 and 54 North Fourth street, Philadelphia, is deservedly attracting considerable attention in electrical circles, and their new insulating joint, illustrated in the reading pages of the ENGINEER, is meeting a yearnful necessity. Mr. W. McDevitt, the exacting insurance inspector of Philadelphia, endorses it fully as to strength and its prevention of electric or gas leakage. It is not only good but cheap, and is extremely durable.

THE BLISS ENGINEERING CO. has been formed to take over the business of Congdon, Bliss & Daniels, the electrical engineers, who have their headquarters in Washington. The deal was carried through by Mr. L. D. Bliss, who will be general manager of the new concern, with Mr. W. B. Lewis as secretary and treasurer. With increased facilities for doing business, the company will push for all the electrical work in the territory to which it devotes its attention.

MR. T. W. NESS, of Montreal, has issued a card announcing his removal to larger premises, No. 749 Craig street, owing to his old quarters having become too small for his increased business. In the new place he will have ample room and the best facilities for carrying on his electrical supply business. Mr. Ness is making a specialty of the manufacture of Bell telephones for export, and any one interested in this business would do well to communicate with him.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

VOL. XIV. AUGUST 3, 1892. No. 222.

ELECTRIC SEARCH LIGHTS.—II.

BY

E. R. Knowles. C. E.

(*Concluded.*)

REFERRING again for a moment to the illustration of the tips of the carbon pencils, Fig. 2, it will be seen that one of them, the lower, or negative, as it is burnt away, is formed into a point or cone, and that the upper or positive carbon is consumed to the form of a cone with its point cut away, and that this point or tip is hollowed out into a concave form called the crater.

The larger portion, about $\frac{9}{10}$ of all the light generated by the luminous arc, is given out by this crater, which acts somewhat as the concave reflector which is frequently placed behind an oil lamp, and reflects the light there generated in an outward and downward direction. If an electric lamp with its carbons placed vertically one over the other as shown in the illustration, Fig. 6, were placed at the focus of a reflecting mirror, only a small proportion of its luminous rays would reach the mirror and be reflected therefrom. In order to overcome this difficulty, it is the practice to place the tip of the upper carbon a short distance behind the tip of the lower carbon as shown in Fig. 5, and to incline the axis of the carbons at an angle away from the vertical face of the reflecting mirror. By this arrangement the carbons will burn away, as shown in the illustration, Fig. 5, and the crater formed at the point of the upper carbon will be on one side and face almost directly towards the reflecting mirror, and in this way practically all the luminous rays therein generated will strike the surface of the mirror and be reflected therefrom.

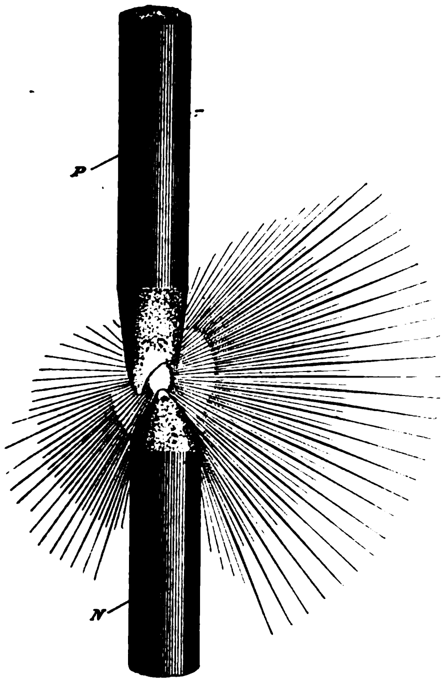


FIG. 5.

The rays of light emanating from a luminous source are not sent out parallel with one another, but are radiated in all directions from a common centre, and in like manner the rays of light emanating from the luminous crater of the electric arc are divergent and form a cone of light whose apex is the centre of the luminous crater, and whose angle of divergence is dependent on the form and size of the luminous crater. Now in order to collect all these divergent rays of light and render them parallel so as to concentrate the light and give it greater penetrating power, advantage is taken of the properties of reflecting mirrors of certain peculiar curved forms, which have the property of receiving upon their surfaces the divergent rays of light from a luminous source, and of concentrating and reflecting them parallel one with the other. A type of such a reflector or mirror is shown in the illustration, Fig. 7, page 98.

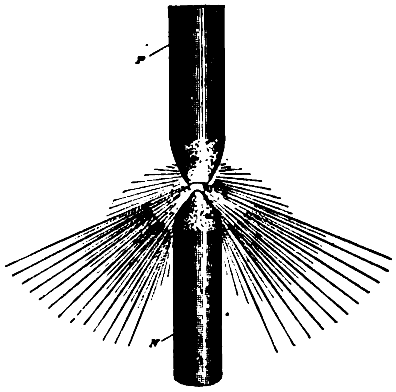
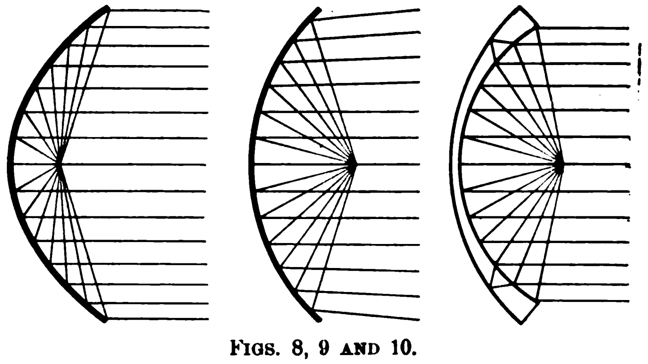


FIG. 6.

There are two general types of these mirrors, those whose curvature is parabolic, Fig. 8, and those whose curvature is spherical, Fig. 9. They are made either of metal or glass. At first they were made parabolic in form, this being a curve which is theoretically the best for the purposes of reflecting in a parallel beam divergent rays of light received upon its surface from a luminous source situated at its focus. But it is a difficult curve to make correctly in metal and still more difficult to make in glass. Metal mirrors made in this form give unsatisfactory results, the metal absorbing about 50 per cent. of the light, so that the



FIGS. 8, 9 AND 10.

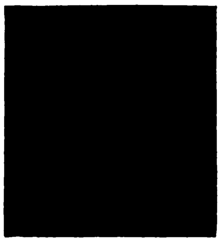


FIG. 7.

reflected beam of light is quite weak and only useful over short ranges of say, a few hundred yards; as a result their use for long-distance projection has been very generally abandoned, their principal use being for locomotive headlights and small reflectors; and mirrors made of glass have taken their place. These were first made of glass silvered on the back, concave in form, of spherical curvature and of uniform thickness throughout. These gave better results, and were less difficult and costly to construct, but spherical aberration limited the amount of surface of the mirror which could be used to advantage, so that a great deal of light was wasted.

By spherical aberration is meant that property of lenses or reflecting mirrors whereby rays of light passing through or reflected by their margins, are more powerfully refracted, that is, brought to a focus nearer the surface of the lens or mirror than those rays which pass through or are reflected nearer to or at the centre of the lens or mirror. When a parallel beam of light strikes upon the surface of a spherical mirror, such as is shown in the illustration, the rays of light composing it are reflected and converged to points upon the axis of the mirror, called focal points or focii.

As the form of curvature of the mirror is part of the surface of a sphere, or one which is generated by the revolution of a circle round its diameter, all the rays of light received upon its surface are not converged to exactly the same point, the rays of light farthest away from the axis of the mirror being refracted or brought to a focus at a point on the axis of the mirror nearer the surface of the mirror than those which are nearer to, or at the centre of, the mirror; so that the rays of light when refracted by the mirror are not all focussed at exactly the same point but lie inside a certain small space upon the axis of the mirror called the principal focus; and conversely, the rays of light emanating from a luminous source, situated at the principal focus of the mirror, are not reflected from the surface of the mirror, parallel one with another, those at the centre of the mirror being sensibly parallel while those at the outer edge of the mirror are more or less divergent from those at the centre.

The problem, then, was to make a glass mirror which should be free from spherical aberration and yet easily constructed and of comparatively low cost. This problem was solved in 1876 by Colonel Mangin of the English Engineers. A cross-section of one of his mirrors is shown in the illustration, Fig. 10, and the mirror Fig. 7, already referred to, is an example of this type.

By combining two spherical surfaces of different radii or curvature, one concave and the other convex, the thickness of the glass between these two surfaces being dependent upon the character or quality of the glass used, and quite small at the centre of the mirror and gradually increasing until it is quite large at the outer edge, Col. Mangin succeeded in producing a lens-mirror, called an aplanatic reflector, which was practically free from spherical aberration. This type of reflector is the one most generally, I may say, almost universally, used in electric projectors.

They are made from carefully selected glass, known as optical glass, especially manufactured for making lenses, mirrors and all optical apparatus. No glass is of such importance in the arts as that of which lenses, mirrors and prisms for optical instruments are made. Both flint and crown glass are applied to these uses, but each of them has its defects. The flint glass, from the great difference in the densities of its ingredients, is with much difficulty obtained of a homogeneous structure, an essential requisite in all glass used for optical purposes. The crown glass is difficult to obtain of uniform composition and texture, due to the high temperature required for its fusion and the resulting tendency to devitrify in cooling; or if this is obviated by an increased proportion of alkali in its composition, this excess causes attraction of moisture from the air and gives a damp surface to the lens. The best flint glass is subject to various defects, chief among which is a wavy appearance called striæ, resulting from a want of uniform density in the glass and a tendency to refract and disperse in different directions the rays of light passing through it; such defects are of great importance when the glass is used for optical purposes.

To stimulate research and the discovery of some means of obviating these difficulties, the French and English scientific bodies offered prizes for a process for making a glass which should be free from these defects. The problem was finally solved by Guinard, a native of Switzerland. By a method which he kept secret, and which was finally communicated to Messrs. Chance & Co. in England, very large plates of flint and crown glass, of pure color, and of such homogeneous structure that light is transmitted through them without polarization, were and are now successfully made. These plates were very costly; a flint glass disc was exhibited at the London exposition in 1888 which was 29 inches in diameter and weighed two hundred weight, and was afterwards sold to the French government for £1,000. Since that time, however, the processes of manufacturing such plates of glass have been greatly improved, and the cost correspondingly reduced, so that now it is possible to obtain at a comparatively low cost optical glass plates of almost any desired size and quality.

The glass used in making the mirrors for the electric projector is very pure and white, of uniform density, and free from all streaks, spots and bubbles. It comes in flat slabs or plates of the required dimensions for making a single mirror. The curves of the back and front of the mirror and the thickness of the mirror are mathematically calculated so as to conform with great exactness to the optical qualities of the glass plate from which it is to be made, each plate being carefully tested for this purpose. A curved form of metal is then made approximating to the desired shape of the mirror, and the glass plate, by careful heating, is made to bend into and conform to this metal form, thus roughly shaping the glass to the desired form of the finished mirror. The outer and inner surfaces of the glass plate so bent are then ground by appropriate mechanism to the required curves and then polished, after which the back or convex surface of the mirror is silvered so as to make it a reflecting surface and is then covered with a coating of protecting varnish to prevent damage to the silvered surface, by scratching or abrasion. A small spot in the centre of the mirror is left unsilvered to serve as a peep sight, by means of which the condition of the electric arc may be seen and examined when the electric lamp is in operation.

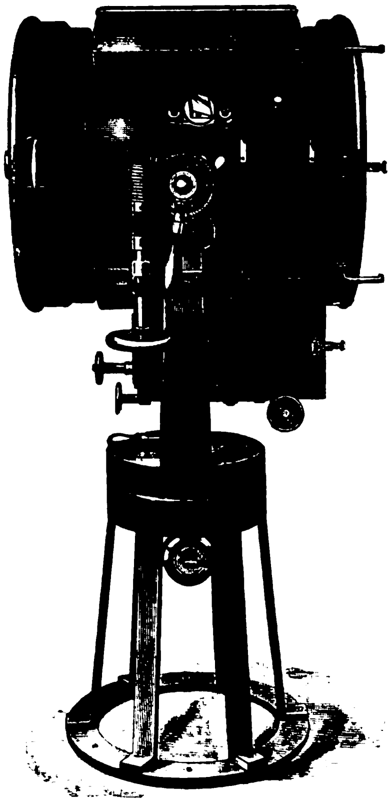


FIG. 11.

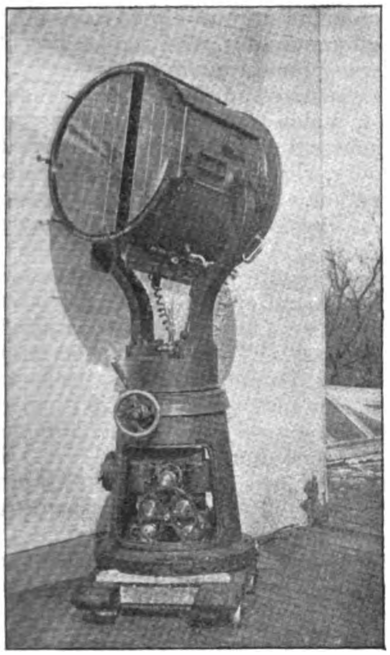


FIG. 13.

The mirror illustrated is 24 inches in diameter, and when an electric arc lamp of 25,000 c. p. is placed at its focal point it will reflect a sensibly parallel beam of light which can be seen for many miles, and is powerful enough to illuminate and render visible a light object such as the white sail of a vessel at a distance of three miles.

Strictly speaking, the mirror does not throw an absolutely parallel beam of light owing to the fact that the source of light is not a point but has a greater or less area which is luminous; nor is it desirable that it should. If the diameter of the beam of light, which, in a 24-inch projector is 24 inches at the orifice of the drum, was maintained constant, it would only illuminate an area 24 inches in diameter at the farthest distance at which it was used. This would appear to the eye as a mere spot of light, and would be of very little value. As a matter of fact, the beam of light is slightly divergent, about two degrees of arc, so that at a distance of, say, 5,000 yards, the beam of light will have spread out and cover an area of about 500 feet in diameter, thus illuminating quite a large area and one, which to the eye, will appear of a size which can easily be perceived and examined.

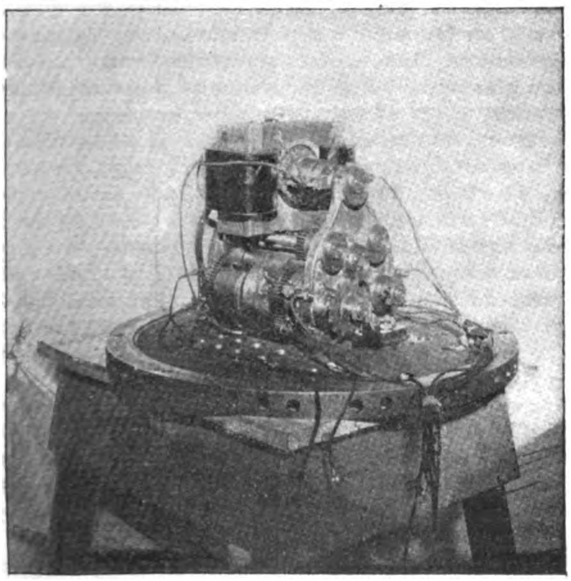


FIG. 14.

Coming now to the mechanism which contains these two essential features of an electric projector, namely, the luminous source of light and the reflecting and projecting device, we have a piece of apparatus, which in its complete form, is shown in the illustration, Fig. 11, and which in detail is represented in Fig. 1. It consists generally of a fixed pedestal, E, upon which is supported a revolvable top, G, to which are attached two vertical arms, F F, forming together what is called a fork; upon the upper ends of these arms is supported in bearings the drum or cylinder D, capable of swinging up and down in a vertical direction. The mirror or reflector, B, is fixed in one end of this drum, and the electric arc light, A, slides in upon suitable guides through an opening in its bottom. At the end opposite the mirror the drum is provided with a door and diverging lenses, L. These diverging lenses and their use will be described further on. I is a lever for locking the horizontally revolving part G in any desired position, and H is a hand-wheel for rotating the part G, and with it the drum D in a horizontal plane. A hand-wheel (not shown) also controls the vertical movements of the drum D. S is a switch for controlling the admission of the electric current to the lamp A.

The tips of the carbons in the lamp and consequently the electric arc are located at the focus of the lens E and the luminous rays from the lamp A are caught by the mirror B and reflected in parallel beam out through the door and lenses L shown in the illustration.

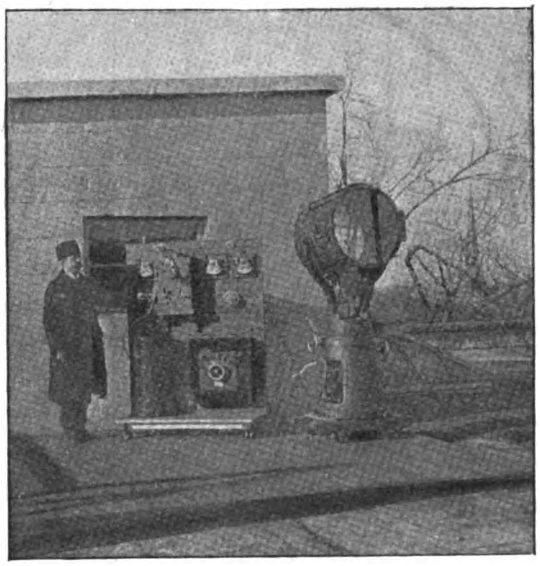


FIG. 15.

The lenses L are for the purpose of rendering the parallel beam of light as it emerges from the drum D more or less divergent, as it is sometimes desirable to spread out the beam of light so as to cover a larger area than it would if the beam of light remained parallel; for instance, it would be used in this way when the projector is in use on a man-of-war and its beams are thrown upon the water close by the vessel in an effort to discover the approach of a torpedo boat. This is accomplished by having two sets of lenses placed one in front of the other, as shown in the illustration, Fig. 12, the one fixed and the other movable. These lenses are strips of glass of alternate plano-convex and plano-concave sections, as shown. When both sets of lenses are directly in front of one another so that a plano-convex strip is exactly opposite a plano-concave strip they act just the same as a flat plate of glass would do, and the beam of light passes through them remains parallel, but if the outer or movable set be displaced sidewise, so that a plano-convex strip is opposite a similar strip, and a plano-concave strip is opposite a similar strip, the lenses act together as a double-concave and double-convex lens would, and the beam of light is dispersed at a greater or less angle according to the amount of motion of the lenses, the maximum angle of dispersion taking place when the movable lenses have been moved a distance equal to their width. By rotating the horizontal part G the beam of light may be directed to any point in a horizontal plane, and by rotating the drum D up or down in its bearings, the beam of light may be directed to any point in a vertical plane, and by combining both motions the beam of light may be directed to any desired point and shifted from one point to another. This general description will give a fair idea of the essential features of the electric projector in its simpler form.

The lamps all operate at about 50-volts pressure, and with currents varying from 25 amperes to 90 amperes, according to size, the list being 25 amperes, 45 amperes, 75 amperes and 90 amperes for the four sizes.

In its most improved form the electric projector is arranged so that all its movements can be controlled and manipulated from a distance. Not only is the lamp automatic in its action, but an electric motor is placed in the base of the projector which trains the projector both horizontally and vertically. From the motor in the pedestal a multiple conductor cable runs to the controlling board, which carries the necessary switches for operating the projector and its lamp. The movement of training horizontally can either be continuous with a divergent beam when the surface of the land or water near by is to be illuminated and the approach of a torpedo boat or an enemy is to be detected, or by small angles at a time with a concentrated beam for long range illumination.

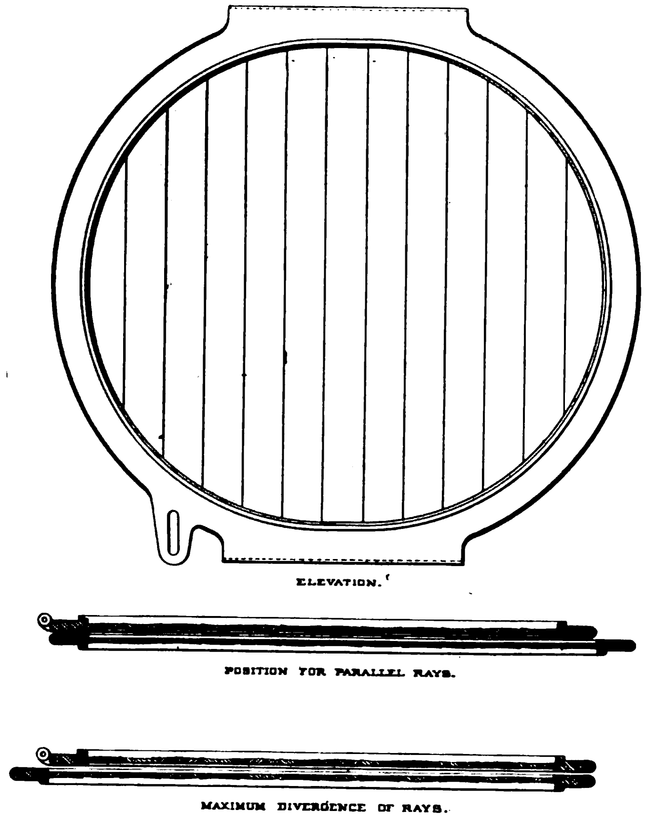


FIG. 12.

Under all of these circumstances the complete maneuvering of the projector together with the starting and stopping of the lamp is regulated by the switches on the controlling or switchboard. In this way, one or more projectors can be electrically controlled, one man only being required who may be stationed in the conning tower of the vessel, or in any other protected position, thus insuring the continuous action of the projectors.

The illustration, Fig. 13, shows a view of the electric projector as it is actually built, the view shown being that of the 24-inch projector made by the Schuyler Electric Company. In this projector everything is made as automatic in its action as possible, and it can be operated as easily by a person distant a thousand feet from it, as by one close at its side. The lamp is similar to the one already described and is automatic in its action, starting itself and feeding its carbons together and running for six hours continuously.

In the base or pedestal is situated an electric motor shown in the illustration, Fig. 14, which by means of gearing and suitable electric connections and switches, can be made to rotate the drum horizontally, right or left, and vertically, up or down, singly or together, at any desired rate of speed, and can be made to stop at any desired point in these movements.

All of these movements are controlled by a combination of switches, shown in the illustration, Fig. 15, which are connected with the projector by a flexible cable containing the necessary conducting wires. These control switches may be located at any desired distance from the projector, so that the operator will be entirely out of the range of the light of the projector and entirely protected from any chance shot directed at the projector in time of war. In actual practice in the navy, the projector is mounted on the deck of the vessel, or on the bridge, or even on the crosstrees on the mast, and the control switch is located in the pilot house or conning tower from which the movements of the ship are directed.

LONG-DISTANCE ELECTRIC POWER TRANSMISSION IN CALIFORNIA.

THE most important electric power transmission plant yet undertaken in this country is one now in course of construction for the San Antonio Electric Light and Power Co. in Southern California. The power plant is located in the San Antonio Canyon where there is a minimum flow of 1,300 cubic feet of water per minute, affording a head of about 400 feet.

The water is brought to the power station through 1,900 feet of 30-inch, and 600 feet of 24-inch, double-riveted sheet iron pipe, which involves a loss of head by friction of 12 feet, leaving 390 feet effective head or running pressure. The laying of the pipe line necessitated a rock tunnel 1,300 feet in length, as well as several heavy open cuts. The power station is provided with four double-nozzle Pelton wheels, 34 inches in diameter, coupled direct to the armature shafts of as many Westinghouse alternating current generators of 200 h. p. each. The wheels will run under above conditions 600 revolutions per minute, giving the same speed to the generators. Two exciters are provided which are also run by Pelton wheels coupled to the shafts in the same manner, of 20 h. p. each.

The current thus generated will be carried on two No. 7 bare copper wires seven miles down the canyon to a point where they diverge, one running to Pomona 15 miles, and the other to San Bernardino 28 miles, covering by the return circuit in the latter case a distance of 56 miles. By means of transformers the potentials will be raised at the generating station to 10,000 volts and the current carried at this pressure to sub-stations located just outside the cities named, where by means of step-down transformers it will be reduced to about 1,000 volts and then distributed for both light and power purposes.

The motors used will be of the Westinghouse synchronous type. The sub-stations will be provided with regulators, by which means the attendant can regulate the voltage of the distributing circuit independently of the generating plant. The necessity of pressure wires upon the voltage system will be obviated by the use of a compensator.

This installation is attracting much attention, as it is by far the highest tension and longest distributing system ever attempted in this country or abroad on so extensive a scale for commercial purposes. There is, however, no misgiving as to results, though it be a long step in advance of anything heretofore accomplished in this direction. The reputation of the firms supplying this equipment, the Westinghouse Electric Co. and the Pelton Water Wheel Co., is a guarantee of the success of any enterprise they may undertake.

MODERN AMERICAN TELEGRAPHIC APPARATUS.—V.

BY

F. W. Jones

There are two distinct methods of applying dynamo currents to the quadruplex system; one is the method adopted by the Postal Telegraph-Cable Company described on page 618 of The Electrical Engineer of June 22, 1892; the other method is the standard of the Western Union Telegraph Company shown substantially in Fig. 5 and exhaustively described in Maver & Davis' book on the quadruplex.

Referring to Fig. 5, P C is the No. 1 or pole-changing transmitter, S T, the No. 2 or heavy current transmitter. Starting at point x, the resistance of the line wire and artificial circuit including the relays is 4,000 ohms, respectively.

Calling the line wire	A =	4,000 ohms,
Artificial circuit	B =	4,000 "
Shunt or leak	C =	900 "
Resistance added to dynamo	D =	600 "
Increase and decrease	R =	1,200 "
Joint resistance of	A and B =	2,000 "

Then the following currents are sent to line:

With No 2 key o	Amperes.	Energy expended. Watts.
Total current....................	.132	42.24
Current in A and B....................	.041	3.36
" " A....................	.0205	1.68
" " B....................	.0205	1.68
" " C....................	.091	7.45
" " D....................	.132	10.45
" " R....................	.132	20.92
With No. 2 key closed.		
Total current....................	.12	43.2
Current in A and B....................	.12	28.8
" " A....................	.06	14.4
" " B....................	.06	14.4
" " D....................	.12	14.4

In Fig. 6, representing the Postal method, like figures represent like parts as in Fig. 5, and the supply of currents and the expenditure of energy during operation are as follows:

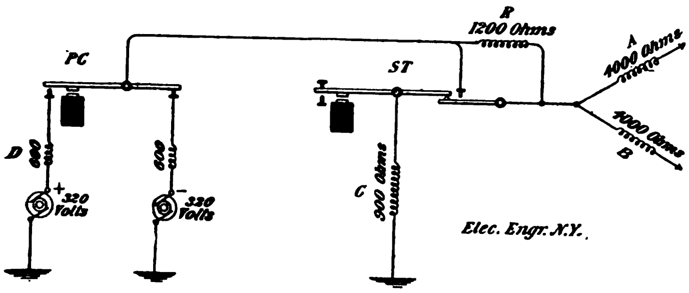


FIG. 5.

With No. 2 key open.	Amperes.	Energy expended. Watts.
Total current....................	.04	4.8
Current in A and B....................	.04	3.2
" " A....................	.02	1.6
" " B....................	.02	1.6
" " D....................	.04	1.6
Wtth No. 2 key closed.		
Total current....................	.12	43.2
Current in A and B....................	.12	28.8
" " A....................	.06	14.4
" " B....................	.06	14.4
" " D....................	.12	14.4

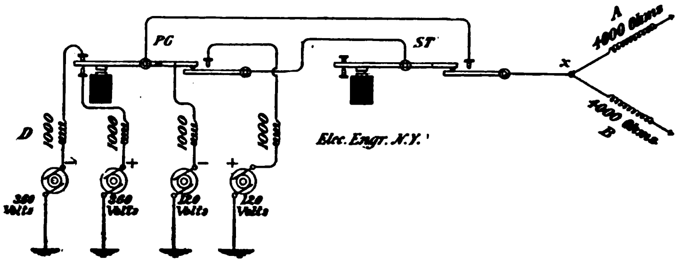


FIG. 6.

Allowing that in each method the No. 2 transmitter maintains a closed contact half of the time that the circuits connected thereto are being operated, the average expenditure of energy per circuit for the Western Union method is at the rate of 40.8 watts, and for the Postal method 24 watts, the former will consume 1,836 watts to supply 45 circuits, whereas the latter supplies the same number at an expenditure of 1,080 watts or at a saving of over one electrical horse power.

On page 455 of The Electrical Engineer of May 4, 1892, Mr. William Finn describes an improvement in the Western Union No. 1 transmitter (P. C. Fig. 5) by which sparking at its points is suppressed. My observation has demonstrated that detrimental sparking occurs between the dynamo contact point and the line at the moment the No. 2 transmitter sends an *agreeing* current to the one being sent by the No. 2 transmitter of the distant station. At this moment over 640 volts are urging a large quantity through the circuit and this causes an arc at the points of No. 1 transmitter. Particularly is this true where the resistance of the line wire and the internal resistance of the leading wires to the generators is low.

In the Postal system where 350 volts are employed on No. 2 transmitter, it will be seen (Fig. 6) that 1,000 ohms of inductanceless resistance of No. 24 or 20 mils diameter german silver well-covered wire, wound upon a tin tube 2 inches in diameter, Fig. 7, is included in each lead between the dynamo and the transmitters. The sparking caused by the operation of No. 1 transmitter when the line wire is detached is not observable, and much less than 1,000 ohms would suffice to afford immunity from sparking under these conditions, but it requires about 3 ohms per volt to restrict the combined incoming and outgoing currents to a harmless degree.

In four years use of these coils, not one has broken down nor required any attention, and they are even better now than when new. The Postal Co. made an extensive trial of incandescent lamps as resistances in connection with the application of dynamo currents, and found their filaments of such a variable nature and the lamps so fragile that their use was discontinued in favor of the tin tube inductanceless coils. It was found that the resistance the lamps interposed in a quadruplex circuit was very different for dots from what it was for dashes, and that much more resistance was needed in the lamp (cold) than in a coil of wire, inasmuch as the lamp would get hot when the No. 2 transmitters of the two stations were closed and the currents were of opposite polarity ; so that any attempt to use the No. 1 transmitter resulted in sparking at its points. The resistance of a hot incandescent lamp is about one-half its cold resistance, and I found that a $3\frac{1}{10}$ watt Edison 16 c. p. lamp, measured :

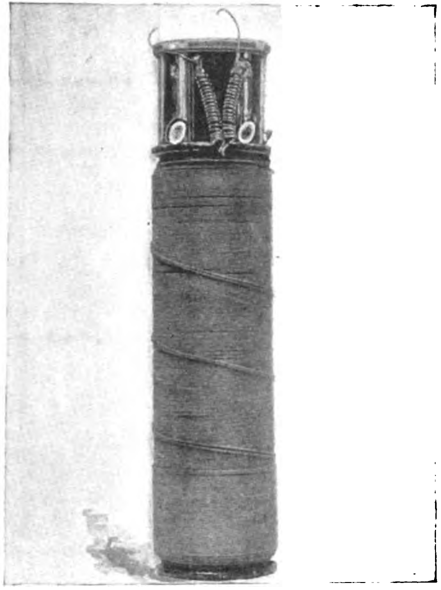


FIG. 7.

330	ohms,	with	.043	ampere.
297	"	"	.100	"
258	"	"	.200	"
239	"	"	.300	"
223	"	"	.400	"
205	"	"	.500	"
187	"	"	.600	"
175	"	"	.700	"
167	"	"	.800	"
159	"	"	.900	"

The value of lamps in indicating by their glow the advent of trouble upon working circuits is probably much larger in theory than in practice, as the troubles that cause a glow are but a small percentage of those that do not, and chief operators would not habitually keep watch for such desultory indications. These tin tube resistance coils are very compact, will stand much hard usage, and their coefficient of variation due to temperature is 0.00044, or nine times less than for copper. They are made up in different sizes to suit the various potentials of the dynamos and applied in the circuits so that at no time shall there be less than $2\frac{1}{10}$ ohms per volt. This prevents all undue sparking on the switches and renders the currents perfectly safe both inside and out.

NEW ELECTRIC ROAD TO CONEY ISLAND.

A NEW electric railroad, to be known as the New York, Mapleton and Van Pelt Manor Railway, is to be operated between Brooklyn and Coney Island, and the company has filed its articles of incorporation at Albany. The route is to be from the Thirty-ninth street ferry, up Thirty-eighth street to the old New Utrecht and Flatbush road to Twentieth avenue, and thence to Bensonhurst and Coney Island. Among the incorporators are Col. Andrew D. Baird, Joseph P. Puels, William P. Rae, Cornelius Fergueson, Jr., and Duncan D. Chaplin.

THEORETICAL ELEMENTS OF ELECTRO-DYNAMIC MACHINERY—X.[1]

BY

A. E. Kennelly

STRESS DISTRIBUTIONS—(*Continued.*)

AT every point of a magnetic circuit, there exists as we have seen, a tension of $\frac{B^2}{8\pi}$ dynes per square centimetre, normal to the equipotential surfaces, and also a lateral pressure of $\frac{B^2}{8\pi}$ dynes per square centimetre acting uniformly in all directions over the tangent plane, the plane with which the equipotential surface at the point locally coincides. Also at every point not occupied by a source of M. M. F., that is, at every point not within the substance of a magnet or active conductor, this distribution of stress is in statical equilibrium, and it would seem that this distribution (or some numerical multiple of the same) is the only one capable of maintaining equilibrium consistent with the condition of pull along the observed paths of flux. Only within the substance of magnetomotive sources—active conductors, and temporary or permanent magnets—is this equilibrium destroyed and resultant moving force brought to bear upon the space and substance occupied by the magnetomotive source.

If the medium composing the circuit, (wood, copper, air, etc.) were divided into any number of volume elements—individual cells of any shape, each element treated as a rigid body would be in equilibrium under the magnetic stress, and would not experience any resultant force urging it against its neighbors. As an example, let us consider the simple and familiar case of a long straight wire carrying a current C. Fig. 21 represents a section of this wire and the space surrounding it in a plane perpendicular to its length. Suppose another and similar section made through the wire one centimetre further on, so that attention may be confined to the lamina of space one centimetre thick between these planes, surrounding and including the wire. Let A B C D be a small element of this space between the radii O C and O D (including an angle $d\theta$) and the circles A E E and C D G whose radii are numerically r and $r + dr$, respectively. The faces A C and B D are equipo-

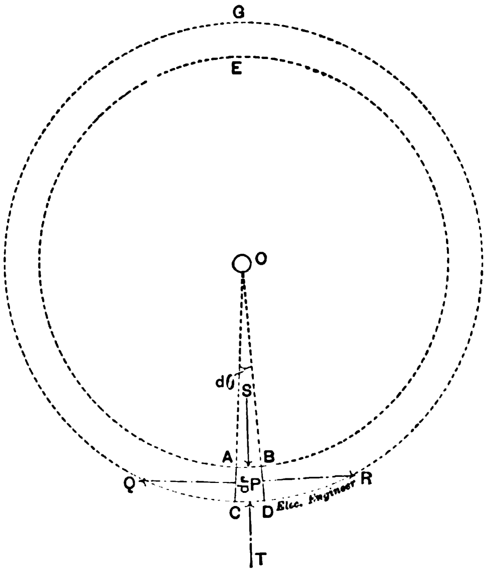


FIG. 21.

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[1] *Copyrighted, 1892, by A. E. Kennelly.*

tential surfaces. Their area is 1 (cm.) × dr, and the intensity by the results of Part II, $B = \frac{2C}{r}$, is perpendicular to them. Considering the element as a rigid body, it will be subjected to pressures on the faces A B and C D, together with tensions across A C and B D. These four stresses may be considered as exerted at the centres of the respective faces and are indicated by the arrows. They may be reckoned as follows :

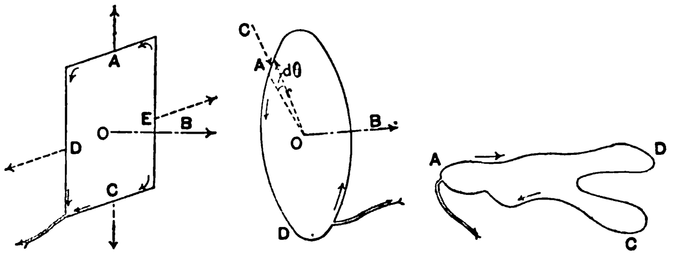
Face.	Force.	Direction.	Theoretical value per sq. cm. dynes.	Local value of B.	Local value of $\frac{B^2}{8\pi}$	Area of face.	Total force acting on face.
A B	Pressure	S P	$\frac{B^2}{8\pi}$	$\frac{2C}{r}$	$\frac{4C^2}{8\pi r^2}$	$r\,d\theta$	$\frac{C^2\,d\theta}{2\pi r}$
C D	"	T P	"	$\frac{2C}{r+dr}$	$\frac{4C^2}{8\pi(r+dr)^2}$	$d\theta(r+dr)$	$\frac{C^2\,d\theta}{2\pi(r+dr)}$
A C	Tension	P Q	"	$\frac{2C}{r+\frac{dr}{2}}$	$\frac{4C^2}{8\pi\left(r+\frac{dr}{2}\right)^2}$	dr	$\frac{C^2\,dr}{2\pi\left(r+\frac{dr}{2}\right)^2}$
B D	"	R	"	$\frac{2C}{r+\frac{dr}{2}}$	$\frac{4C^2}{8\pi\left(r+\frac{dr}{2}\right)^2}$	dr	$\frac{C^2}{2\pi\left(r+\frac{dr}{2}\right)^2}$

The table shows that there will be a difference of pressure on the inner and outer faces of $\frac{C^2\,d\theta\,dr}{2\pi r(r+dr)}$, or ultimately $\frac{C^2\,d\theta\,dr}{2\pi r^2}$ dynes in the direction S P, because the flux is stronger on the inner side, and the stress varying as its square, more than compensates for the difference in area. On the other hand, the tensions are seen to be numerically equal, but they are not exactly opposed, being inclined to each other at an angle $2\pi - d\theta$. The effect of this inclination will be a resultant pull of $\frac{C^2\,d\theta\,dr}{2\pi\left(r+\frac{dr}{2}\right)^2}$ or ultimately $\frac{C^2\,d\theta\,dr}{2\pi r^2}$ dynes inwards in the direction T P, just counterbalancing the resultant side thrust. The element is therefore in stable equilibrium, and since the same could be proved for any similar small cylindrical element outside the wire, it must follow that any larger portion of the space, which could certainly be built up of such adjacent elements, would be in similar equilibrium regarded as a whole.

The proposition arrived at in the foregoing simple case is of general application no matter how complex or irregular the flux distribution may be, and may be stated in the following terms. The resultant side thrust that may be exerted upon any element of the magnetic circuit (not included in the substance of a magnetomotive source) due to the variation of the intensity B in or round it, is balanced by the resultant tension in the opposite direction owing to the local curvature in the flux. In fact uniform flux is straight, while variable intensity always bends so as to keep convex on the weaker side. In other words, the divergence of equipotential surfaces implies not only weakening but also bending in the flux channels, the two effects everywhere maintaining statical equilibrium.

We observe therefore, that when an inactive conducting wire is situated in a prime flux density B, the stress distribution is in equilibrium throughout the field, in the substance of this wire as well as all round it. As soon as a current C is established in this conductor, the flux distribution from the current will have been superposed upon the prime system. The resultant system of stress distribution will again be in equilibrium at all points outside the wire, but there will no longer be equilibrium in the space occupied by the wire.

Regarding the wire as a mere filament without sensible cross-section we have seen that the resultant vector force acting upon it will be $P = V.\ C\,B$, and this force must be applied to the wire to restore equilibrium between its substance and its environment. When the cross-section of the wire cannot be fairly considered negligible, it may be divided into filaments, each carrying its appropriate share of C. The consequence of applying the rule $P = V.\ C\,B$ to each filament in succession, will be that B the prime intensity for any one filament, will be modified by the flux from all the remaining filaments. The vector force on the wire as a whole will still by summation be $P = V.\ C\,B$ as before, where B is the prime intensity for $C = 0$; but there will now be a system of mutual forces between the filaments in addition. These filaments in fact attract each other, and the resultant forces of the mutual system will depend upon the curvature of the wire, as well as upon the dimensions of its cross-section. For a long straight wire of circular section, with a current density of σ units (C. G. S.) per square centimetres, the force on any element of the conductor at radius vector R will be $P = 2\pi R\sigma^2$ dynes per cubic centimetre, agreeing with the force at the surface noticed in Part IX. Practically, the external resultant $V.\ C$B is simple and important, while the internal system of forces through the substance of the wire is more complex, and rarely needed.

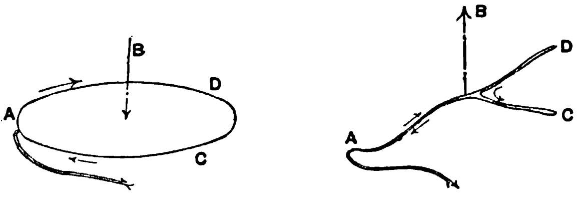


FIGS. 22, 23 AND 24.

It may be advantageous to analyze a few simple systems of electromagnetic force distribution. Fig. 22 represents a wire A D C E bent into a square, the length of one side being, say, S centimetres. The square is supplied by two wires held very close together, with a current C; and its plane is perpendicular to a uniform prime intensity B represented by the arrow O B. Viewed on this side, the current circulates counter-clock-wise. The electromagnetic force acting on each side of the square due to B and C will be $S\ C\ B$ dynes, represented by the arrows at A D C and E, in the same plane.

These will not be the only forces acting on the wire, for should the prime flux B be withdrawn, there would still be a magnetic circuit having its M. M. F. in the turn of current and its flux threading the loop in the same direction as the prime flux O B. Although the distribution of this local flux would not be uniform over the square, the resultant effect will be to establish forces on the sides in the direction of the arrows. The complete system of forces will then be triple. First a compression of the wire towards the axis due to filamentary attractions; second, a set of forces acting outwards and perpendicular to each side, the action varying in intensity from point to point since the flux distribution is not uniform; and third, a force $S\ C\ B$ acting on the establishment of B the external M. M. F., which force s perfectly uniform, namely : $C\ B$ dynes per unit of length along any side. Of these three systems, the first two are evidently not reversible in direction when the current in the square is reversed, because the two factors, local flux and local current reverse together. The third system is however reversed by a change in the direction of current, or external flux B.

In Fig. 23, a circle A D B is substituted for the square of Fig. 22. Here the force on any small arc $r\,d\,\theta$ due to the action of B and C is $r\,d\,\theta\ C\ B$, and according to the direction of current shown it will in this instance be directed towards the centre. Summing all such elements, the total resolved force across any diameter will be $2\,r\ C\ B$ and half this, or $r\ C\ B$ will be the pressure that the wire must at every point longitudinally support. The triple system of forces will again be : A compression of the wire ; a radial thrust of all the parts of the circle outwards due to the application of the rule $V.\ C\ B$ for its own flux local flux, (in this case a symmetrical stress system), and third, a thrust radially outwards, or inwards, bringing a longitudinal stress of $r\ C\ B$ dynes on the wire according to the direction of the external flux B. In this case it will be possible for the second and third systems to oppose and exactly neutralize each other.



FIGS. 25 AND 26.

As a more general case, suppose a loop of perfectly flexible wire A B C, Fig. 24, to lie in a horizontal plane and to be capable of moving only in this plane. This condition eliminates any disturbance due to gravitation. On passing a current in either direction through the loop, the forces set up will expand this, until equilibrium is found in a circular form, and further expansion is resisted by longitudinal tension. This expansive tendency will be further assisted by an external flux vertically downwards, as shown in Fig. 25. If, on the contrary, a prime flux had been established upwards through the loop before the current passed in the direction of the arrows, the loop would have tended to collapse and assume some such form as that in Fig. 26. Total collapse will be resisted by the local magnetic circuit and its outward stress system. The equilibrium would in any event be unstable, and if free to move, the sides of the loop could cross each other until the wire opened out into a circle like that in Fig. 25, but with a cross at A, and with the direction of current opposite to that indicated.

This triple system of forces forms perhaps the simplest analysis in these instances, but it would, of course, be possible to arrive at the same results by determining the resultant system of flux in and outside the loop due to its own M. M. F., and that of the external source, followed by a calculation of stresses on the conductor from point to point by the fundamental laws of tension and side thrust.

MR. R. G. BROWN is leaving per "Gallia" for London and Paris, and expects to be home September 17.

INSULATED ELECTRIC CONDUCTORS[1]—VI.

BY

James Bowstead Williams M.D.

Gutta-Percha.—This substance, when pure, is obtained by evaporating the fresh milky juice of the isonandra gutta, and of over 30 different varieties of trees which grow in Sumatra, Malacca and adjacent islands.[2] Although the general properties of these various guttas are similar, yet, as would naturally be expected, there is a marked difference in their physical and insulating properties, especially when subjected to heat. Thus we find that some guttas will insulate fairly well when subjected to 150° F.; others will insulate at a higher temperature, but if the temperature to which even the best qualities are subjected exceeds about 200° F. their insulating properties are almost if not entirely lost. In this respect gutta-percha differs from india-rubber, for the best qualities of the latter will possess insulating properties when heated considerably above 200° F.

Gutta-percha is sold in the form of blocks, irregular lumps, and in masses resembling chips of wood. When pure, and in thin layers, it resembles, to a great extent, the membrane found on the inside of the shell of a hard-boiled egg, both in color and tenacity. The color of the imported masses, however, varies from light grey to brown. This variation in color is caused by the presence of bits of wood, dirt, foreign juices, etc., which have become intermingled with the milk of the trees during the processes of collecting and preparing the gutta-percha for exportation, and also by portions of the coagulated juice which have become oxidized.

When exposed to the air, pure gutta-percha changes to a brown color, gets full of cracks and is transformed into a brittle, resinous mass. This degeneration is caused by oxidation, and is increased by the presence of light and heat, and especially by alternate dryness and humidity. But if the gutta be kept under water there is practically no change, even after years of immersion. Owing to the changes above mentioned, it is not suitable for insulating aerial conductors, and should only be used for insulating submarine cables—for which purpose it is the best-known insulating material—and conductors which are to be kept continually under water or other liquid which does not attack it.

This substance can be obtained in a pure state by dissolving the best raw gum in benzole, allowing the impurities to settle from the solution, and then evaporating the solvent. When thus purified and free from moisture, its insulation resistance is nearly equal to that of india-rubber. Other hydrocarbons can be used as solvents for it. Paraffine wax is sometimes used as a solvent, but the high temperature necessary to effect a solution is injurious to the paraffine.

It can be incorporated with india-rubber and rubber compounds, both vulcanizable and unvulcanizable. When thus used, it imparts toughness and solidity to the mixtures.

As imported, it often contains adulterations which are introduced, either by accident or design, by the natives who gather and prepare it for shipment. Prominent amongst these adulterants are the coagulated foreign juices before mentioned, which resemble the true gutta in appearance. Some of them ferment easily and are not only of themselves changed to resinous bodies, but impair the durability and insulating properties of the mass. Other impurities are removed by the cleansing processes to which all kinds of gutta-percha are subjected before being used for insulating purposes.

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[2] The word "percha" is derived from "poulo pertja," the native name for the island of Sumatra.

On account of the toughness and inelasticity of this substance, it requires more care and trouble to prepare it for use than rubber. While rubber may be cleansed when in comparatively large masses by the simple process of soaking in a warm alkaline solution and then passing the soaked lumps through a washing machine, the gutta must first be cut into small pieces, then soaked in water, next torn into small shreds and the shredded pieces well washed and dried. The dried pieces are then kneaded in a kneading machine in order to unite the pieces into a homogeneous and compact mass. The gutta, being porous, is almost certain to retain moisture in its pores. If this moisture be not removed before the material is used to form the dielectrics of cables, and the moisture evaporates during the manufacture of the cables, air will take its place; those portions of the gutta in immediate contact with the air oxidize, and the imprisoned air becomes a fruitful source of trouble when the cables are laid in deep water.

Gutta, like rubber, may be combined with "preservative material;" but as preservative material—wood tar, for example—always tends to lower the melting point of combinations of itself with both gutta and rubber, it should be used, if used at all, in very small proportionate quantities, unless the gutta is to constitute the basis of a vulcanized composition, or is to be used in cold climates.

If gutta could be thoroughly protected from air and moisture it could be used to insulate aerial lines. But as its specific resistance is lower than rubber, and its electrostatic capacity and cost greater, there would be no advantage attending its use unless it would be to obtain a firmer and stronger dielectric than one formed of rubber. Besides, every one who has given the matter much attention knows how extremely difficult it is to produce air and moisture proof envelopes—metallic sheaths excepted—for insulated aerial conductors.

Gutta-percha can be used either vulcanized or unvulcanized and in combination with resins, tars and mineral substances, such as oxide of zinc, silica, chalk, etc. Since its first introduction into England it has been made the subject of hundreds of experiments which have been conducted with a view to increasing its utility and durability, and of effecting useful combinations of itself with other insulating materials. To give even an outline of the scope of these experiments would require too much space; but if the reader wishes to acquire a general knowledge of the manufacture, uses and applications of gutta and its compounds —and also of india-rubber—he can do so by consulting the abstracts of British patents on gutta-percha and india-rubber, copies of which should be in every public library.

Gutta-percha can be used to insulate conductors which are inclosed in subterranean pipes or conduits, provided such conduits are kept filled with water by means of reservoirs placed at greater elevations than the conduits, and the temperature of the water is not sufficient to cause softening of the gutta. The insulated conductors thus placed practically become subaqueous cables, and if the proper conditions are maintained there is no reason why such cables should not be as durable as the submarine cables. Furthermore, these cables would not be subjected to the destructive agencies which are continually at work upon the submarine cables.

The best qualities of gutta are known in commerce under the names of gutta merah, gutta taban, and gutta derrian, and these contain the least amount of resinous matters. They are mostly obtained from Java and Macassar. The poorest qualities come from Borneo—some of the best qualities are obtained from Borneo—and contain the largest quantities of the foreign juices and resins.

Mr. W. S. Kelly will hereafter be connected with the General Electric Co. and will have his headquarters in Boston. He will be engaged upon power transmission, especially in connection with mill work and isolated plants.

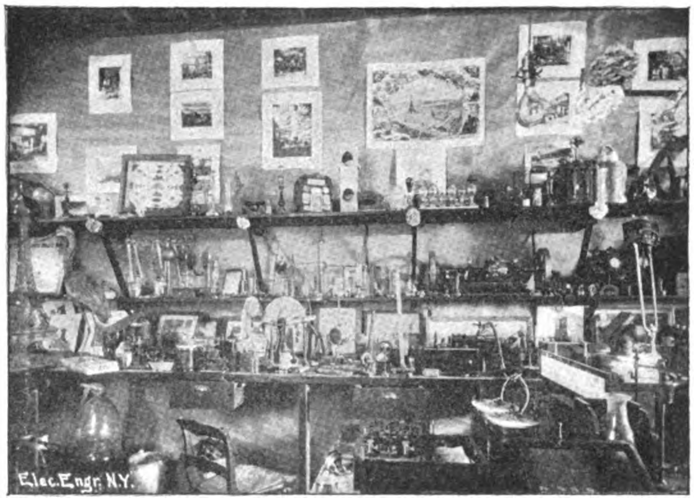
THE FRANKLIN EXPERIMENTAL CLUB.

BY

Wm. J. Hammer

The Franklin Experimental Club, of Newark, N. J., was organized Jan. 31, 1890. The object of the club, as stated in its constitution, was the advancement of its members in scientific knowledge by study and experimental research through the helpful influence of united effort. It was a modest little organization, composed of a small but earnest band of workers, and during the past two and a half years it has accomplished much of the work which its enterprising members had laid out for themselves.

So little has been known of the Franklin Club that it may, perhaps, be appropriate at this time to refer briefly to its aims and its accomplishments, particularly as the rooms occupied by the club were destroyed by fire on the night of the Fourth of July last. The fire originated in an adjoining saloon, and soon spread to the Franklin Club, which its facetious members frequently referred to as the "Chinese Laboratory," by reason of its occupying the premises over Mr. Sing Lee's laundry. The club and Mr. Lee were soon upon speaking terms, owing to the "high periodicity" of the upset battery jars and chemicals in the club rooms. The bare beams and walls of the club the members covered with heavy paper, hung with many photographs, pictures and diagrams. At the time of the fire a dozen or more flags from various parts of the world brightened the room. The members despised not the day of small things and looked forward to an early removal to more elaborate quarters and a broadening out of its sphere of usefulness. The accompanying illustrations give a fair idea of the electrical and other apparatus belonging to the club, and they possessed, also, quite an outfit of chemicals and a library of books. All the electrical and other scientific papers were on file, and the club-rooms were supplied with electric light, both arc and incandescent, and with heat and water. The fire is a serious blow to the club as there was but a small amount of insurance, one member alone losing several thousand dollars in books and apparatus.



Franklin Experimental Club, Newark, N. J.

The dues for active membership were $1 per month and the initiation fee $5. There were active, associate and honorary members; a portion of the receipts went towards an apparatus fund, and the balance was used for the working expenses of the club. Each member was supplied with keys to the rooms, to which he had access at all times. All apparatus, books, etc., whether the property of the club or of individual members, were at the disposal of all the members and were kept in order by the club's curator. Lectures and informal talks were given by the members and invited guests, and special encouragement was given to original experiments and the construction of original apparatus.

Prior to the incipiency of the Franklin Club the writer had broached to a number of influential men a scheme for the establishment in New York of a scientific laboratory and museum, where popular scientific lectures, á la Faraday and Tyndall, should be given, and where youths possessing scientific tendencies could spend their spare time in study and experimenting under the guidance of able instructors and without being put to any expense, care being taken that such privileges were extended only to such as were properly fitted and really desirous to avail themselves of such opportunities. In connection with this lyceum would be a scientific museum where valuable historical relics, those "scientific footprints in the sands of time" would find a home and proper care. Here, also, would be shown working models demonstrating the first principles in sound, light, heat, electricity, magnetism, etc., so arranged that the signs could read "please handle" instead of the usual "please do not handle," and each with a few terse words on an accompanying card explaining the principle enunciated. The scheme would, of course, embrace a workshop supplied with electric power, and an important feature would be a scientific library and reading-room where all the scientific papers would be on file. The writer did not succeed in arousing much interest at that time, but that was long ago, and in 1889 he visited the "Urania" Museum in Berlin, which has been fostered by the authorities and many eminent men, with Dr. Werner Siemens at the head. Here is shown, on a small scale, just such a scheme as the writer had proposed, and upon his return to America he made another effort in that direction and eventually took the initiative in the starting of the Franklin Experimental Club. Is not the time now ripe for some such scheme to be taken up by the public-spirited citizens of New York? Will this not be the means of popularizing science in a way that the growing taste of our enlightened people demands? Would not the co-operation of the electro technical press, the electrical societies and the electrical financiers secure it? It would seem so. Is there a question as to the inestimable value to our people of our art galleries, our museums of natural history, etc., our conservatories of music and our public libraries? And yet these would all be subordinated in the public esteem to such an institution as above referred to properly endowed and equipped and run upon the broadest humanitarian principles.

Franklin Experimental Club, Newark, N. J.

ELECTRICAL ENGINEERING AT TULANE UNIVERSITY, NEW ORLEANS.

Among the numerous evidences of progress which the South is now affording none is more significant than the opportunities offered students for obtaining instruction in the higher branches and especially in the mechanic and electric arts. Where thorough, scientific training precedes or follows practical work in any branch it must of necessity be done with more intelligence and hence with better results than where the rule-of-thumb method alone is employed, and this is especially the case in electrical work. It was with the object of affording both theoretical and practical training in electrical work that the course of electrical engineering was organized at Tulane University, of New Orleans. This institution as now organized was started in 1884, and was the result of the turning over by the State to the Tulane administrators of the old and poor University of Louisiana. In reality it is a new school, and considering the comparatively short time it has been in operation the progress has been remarkable.

This has been particularly the case in the Department of Physics which is in charge of Prof. Brown Ayres, who has also organized the Department of Electrical Engineering, which has been considerably developed during the session of 1891-92.

The student is given a thorough course of theoretical instruction in electricity and magnetism, accompanied by lectures and practical demonstrations and exercises on the applications of electricity to lighting, and the distribution of power, and to telegraphy and telephony.

But it is in the electrical laboratory that the student requires much of that practical knowledge which he is called upon to employ in the practice of his profession, and hence Prof. Ayres has taken special pains to make the electrical engineering laboratory as complete as possible.

The accompanying engraving shows this laboratory, which contains a variety of apparatus probably not excelled by any similar institution in the country. Thus we find here the following apparatus:

A complete plant of the Slattery induction system, including dynamo of 300 lights capacity, exciter, all necessary station instruments, converters, ranging from 5 to 50 lights capacity, alternating meter, and a large cabinet switchboard of slate of the best finish. A Wood arc lighting dynamo of a capacity of 15 lights, with all necessary station instruments and arc lamps. An arc lighting dynamo of the Edison General Electric Company of 8 arcs capacity, with all necessary station instruments and a full complement of lamps. Four smaller Edison incandescent machines, for use as motors and in laboratory practice in the study of the principles of dynamo machines and the various investigations connected with the distribution of potential, the law of the electromagnet in dynamos, magnetic leakage, etc.

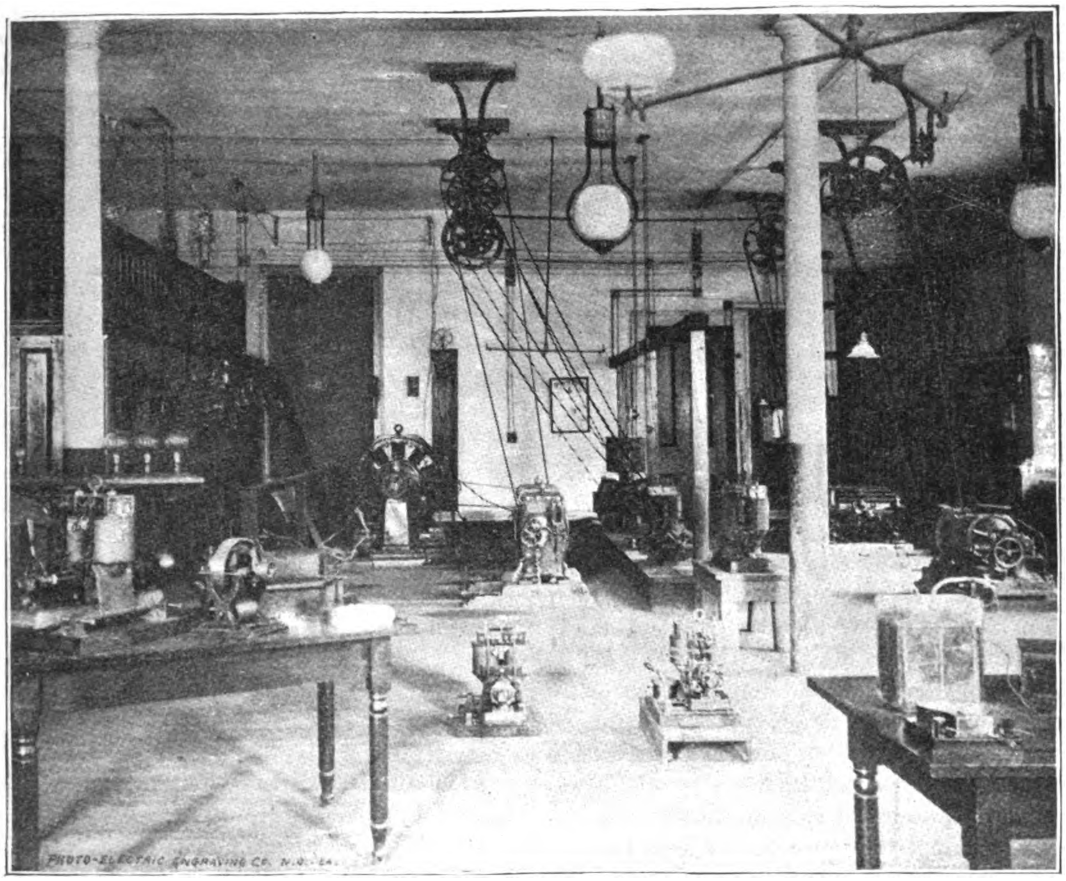
Besides this there are several other arc machines and motors of various makes, and a full equipment of measuring instruments by the best-known makers.

The practical work in the laboratory includes the testing of the machines for conductor and insulation resistance, the study of the law of the electromagnet in dynamo machines, the determination of the strength of field in absolute measure, the mapping of the characteristics of shunt, series, and compound machines, the determination of the electrical and commercial efficiencies of dynamos and motors, the determination of the candle powers of arc and incandescent lights, and the study of the influence on them of varying conditions of potential, etc. Some practice is also had in laying out installations and in designing machines and appliances to fulfill definite conditions.

For advanced students there will be a course during the next session based on Emtage, Mascart and Joubert, and Maxwell. To follow this course a good working knowledge of the calculus will be esential. Every encouragement and facility is extended to post-graduate and other advanced students, both in the laboratory and in their theoretical studies, as it is the desire of the university to build up this side of their work as rapidly as possible.

Ten post-graduate scholarships, entitling the holder to free tuition and one hundred and fifty dollars, are awarded annually to graduates of Tulane College.

Tulane University, we may add, has the largest endowment of any college in the South, with the exception of the Johns Hopkins University, and the largest number of students in all departments, there being no less than 951 students on its rolls, not including 333 who attend the free drawing classes.



Electrical Engineering Laboratory, Tulane University, New Orleans, La.

THE TROLLEY DOG.

Sitting out in the open air a few evenings ago at the house of a friend in umbrageous Greenwich, Conn., a New York electrical engineer remarked as his face took on suddenly an intent look of surprise:

"I didn't know you had any trolley cars here."

"Well, we haven't," was the reply.

"Funny, any how. I didn't see any as I passed through the town, but I'll swear that nothing but a trolley car could make that noise. Listen!"

Everybody listened, and sure enough through the still night air came that curious rolling, whirring, buzzing, rushing sound that accompanies the passage of an electric car as its trolley pole follows the overhanging wire and its "pick-up" wheel makes flying contact.

The host smiled. "That isn't a trolley car," he said, "it's a trolley dog."

Greenwich is celebrated as containing the residence of a noted electrician, who has long been connected with Edison, and who has filled his beautiful house with all kinds of his own electrical contraptions for use and comfort; and it flashed across the mind of the New Yorker that this must be one of the latest productions of his fertile brain. He supposed, he said, that it was an imitation dog, with a motor in his little inside, running around a track; but he didn't see where the utility of the invention came in.

"No," replied the host, "we havent got anything of that kind yet from Electric Hill, but I guess this real piece of flesh and blood machinery deserves a patent. One of our parsons here has a dog of extremely peripatetic tendencies, and so he has put up a big fence right around the grounds. On a rod on top of that fence runs your trolley, to which is attached a long chain. The other end of the chain is attached to the dog. When the dog starts on a tour of the grounds you hear his trolley. He can't get out, and like a trolley car he must follow the circuit, but as long as he does that, he can go on and on like Tennyson's brook. It is a great scheme. Just hear him now!"

And the noise came again, and again, for all the world like a trolley car running fifteen miles an hour.

Mr. W. J. Hammer, of the Temple Court Annex, Nassau street, this city, has just returned from England, where he has been spending several months as the special representative at the Crystal Palace Electrical Exhibition of a number of American electrical firms and inventors. His exhibit attracted a great deal of attention, while Mr. Hammer found his time fully occupied in negotiations and in social duties, his acquaintance in England being quite extensive.

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VOL. XIV. NEW YORK, AUGUST 3, 1892. No. 222.

Without a knowledge of science the practice of art is mere empiricism, often involving operations which are not only unnecessary to the production of the desired result, but frequently detrimental.—Joseph Henry.

A LABORATORY FOR BEGINNERS.

THE interesting article in our present issue, by Mr. W. J. Hammer, on the work of the Franklin Club at Newark, contains more than one valuable suggestion. It will be seen that the Club was, on one side of its work, a practical laboratory, where the members could try their prentice hands in testing the truth of principles or the value of any presumably new ideas that had occurred to them. In this way they were enabled to get an acquaintance with electricity, at close range, which they could hardly get otherwise, and could supplement lectures and reading by the instruction derived from seeing and handling. Mr. Hammer is quite right in emphasizing the importance of such teaching, and we can only hope that his suggestion looking to the establishment of a similar laboratory in New York could be carried out. Probably the New York Electrical Society is the best body to attempt anything of the kind, and it is noteworthy that for some time past, thanks to the enlightened policy prevailing at Columbia College, the Society has had a liberal use of the appliances of the Electrical Engineering Department there. But it would be well, of course, if the Society had an equipment of its own, available by members only. We do not mean a place where all the members, at their own sweet will, could make a wasteful use of material in bangs, stinks and short-circuits, but where, under judicious guidance, they who were anxious to increase their knowledge and train their hands could be assisted over the rough places and could feel themselves advancing in the art. Even then, it might be difficult to help the embryo inventor, as that kind of person is nearly always more or less suspicious and prefers to work in the dark, only to discover, often, when he does unfold his project, that his pet invention was made by somebody else ten years before Christ. But there is no doubt that some young men would gladly avail themselves of the chance to make a few tests of the ideas that are haunting them day and night.

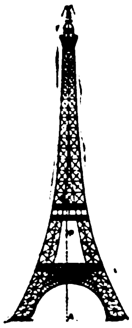
A PROPOSED CHANGE IN UNITS.

HARDLY has the system of absolute units, as employed at present, gained firm ground when there are already attempts made to substitute others designed to still further simplify our methods of calculation and our conception of the interrelation between the units of length, time and mass. Among those who propose such a change is Prof. Ostwald, upon whose system a writer in *L'Indûstrie Electrique* looks with considerable favor. Starting with the idea that the general system of absolute units has for its final object to give an expression for energy in all its forms, Prof. Ostwald proposes to consider the latter as the fundamental value; length and time would be retained, whereas mass would be abandoned. In this way the formulæ of dimension in mechanics become more simple and more easily comprehensible. In each particular branch one value added to the three first would give the complete definition of all values. For example, in the case of heat, one would define temperature, and specific would follow as a derived value; in the case of electricity one would define arbitrarily the unit of E. M. F. or of quantity, or any other constant that one wished to represent by a standard. We would thus avoid the introduction of mass in an artificial way in a domain which would appear to be foreign to to its nature. With a well-known electrician in England vehemently protesting against the loading down of the science of electricity with units which, he claims, as often hamper the student as aid him, the proposition embodied in Prof. Ostwald's system may be looked upon with more favor than a change of this nature ordinarily would be.

DYNAMO TELEGRAPH WORK.

IN continuing his valuable series of articles on modern telegraph apparatus Mr. Francis W. Jones has taken up the subject of the substitution of dynamos for galvanic batteries in the operation of telegraph circuits. Although we were slow to adopt this system in the United States, the number of plants now in operation in this country exceeds those of any other country, and with the experience gained improvements are being introduced. Mr. Jones calls special attention to the departure taken in the arrangement of the machines of the Postal Telegraph Co. as distinguished from that in vogue in the Western Union service. While the latter company place all their dynamos in series, those of the Postal Telegraph Co., as arranged by Mr. Jones, are independent units which can be coupled to the desired potential as the service demands. Mr. Jones shows that by this arrangement considerable economy in power is obtained, and that the machines work to the best advantage. He also touches upon a subject which would bear further investigation, namely, the amount of retardation introduced into the circuit by the employment of the dynamo, owing to its dynamic inductive action, an effect which evidently is not present when batteries are employed.

THE FALL OF BODIES AND THE RESISTANCE OF THE AIR.



AN exceedingly interesting series of experiments is now being carried on in Paris, by MM. Cailletet and Colardeau, in which they are seeking to verify the law of falling bodies and at the same time those of the resistance of the air to the passage of bodies. Now that high speed electric railway work is seriously contemplated, the results of these experiments cannot fail to be of the highest interest. In order to carry out their work, the investigators have installed their laboratory on the second landing of the Eiffel Tower which gives them a free fall of 120 meters, or about 370 feet.

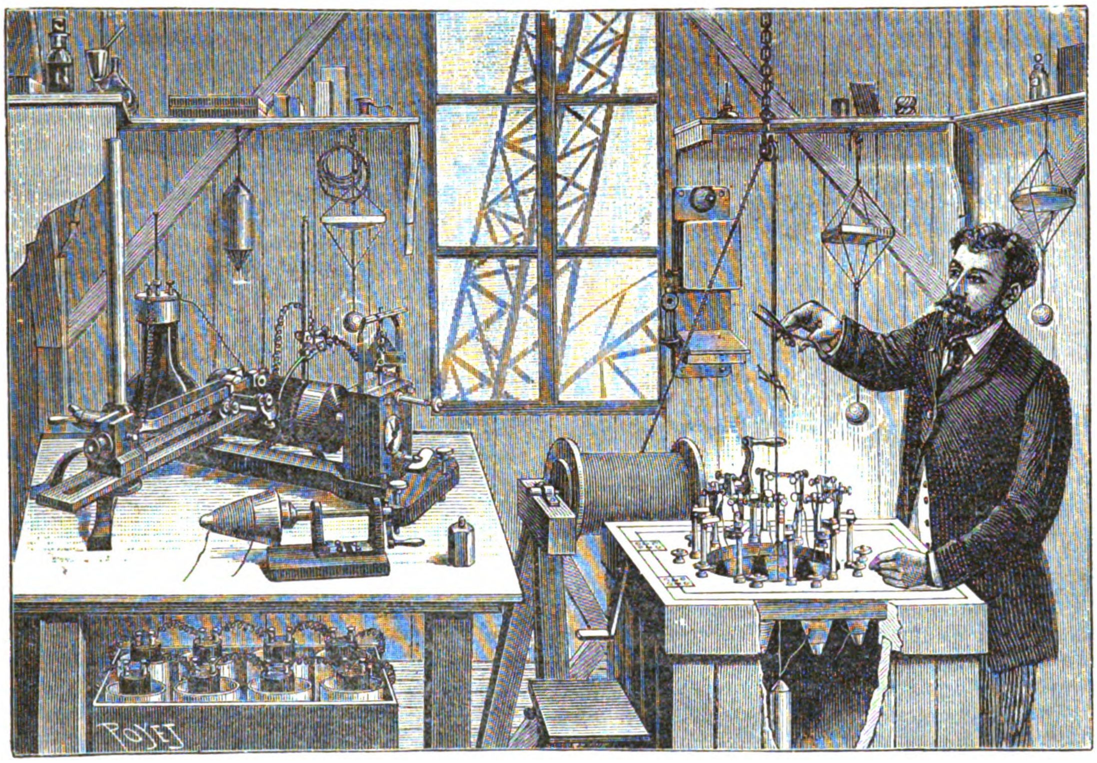


Fig. 1.—Laboratory in the Eiffel Tower, Paris.

In carrying out their experiments MM. Cailletet and Colardeau have employed a very ingenious electrical method of timing the fall of the variously shaped objects experimented with, and particularly with the view of knowing at every instant the position of the falling body. The laboratory itself is shown in the accompanying engraving, Fig. 1, taken from *La Nature*. Fig. 2 shows an enlarged view of the principal apparatus. The falling body is attached to a very fine light thread which is divided into sections of 20 metres each; each one of these sections is wound on a wooden cone, c^1, c^2, c^3, etc., all fixed vertically with their points facing downward so that the thread is very easily unwound. When each of the sections of 20 metres is unrolled, an electric contact actuates a registering pen upon which an electric tuning-fork chronograph indicates the instant with a precision of $\frac{1}{100}$ of a second. Thus at the end of every 20, 40, and 60 metres, etc., a time record is automatically made.

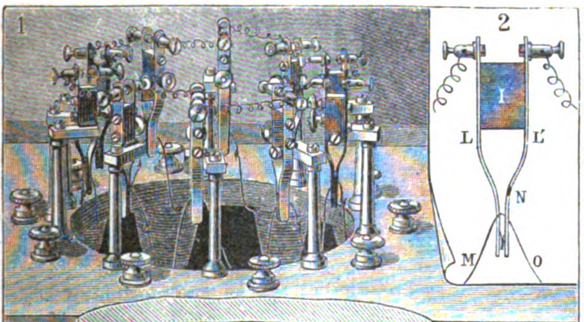


Fig. 2.—Apparatus for Experiments with Falling Bodies and Air Resistance.

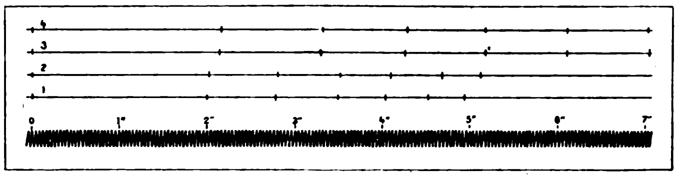


Fig. 3.—Record of Falling Bodies.

The electric contact is accomplished as follows: In passing from one cone c^1 to the following c^2 the thread is looped around a contact M N O, Fig. 2, the contacts being separated by an insulating block I and supported by two springs L L', which press the contacts together very lightly. The falling body pulls the thread through the contacts and thus for an instant breaks the circuits and allows the pen to register. Experiments have shown that the retardation to the fall of a body weighing 1 kilogram through 20 metres caused by the separation of the spring contacts is less than 0.2 millimetre per second; that is, less than 1 one-hundred-thousandth. The retardation due to the resistance offered to the unrolling of the thread on the cone has been shown be about 1 per cent.

Up to the present the experimenters have confined themselves to investigation to ascertain if the resistance opposed by the air to plane surfaces of equal area, moving in a direction normal to these surfaces was dependent upon their form; thus they have employed circular, square, triangular, etc., surfaces. They have found that the time of fall differs only by insignificant amounts, as indicated in the record reproduced in Fig. 3. This figure is a production of the chart obtained by means of the apparatus above described. No. 1 is the theoretical record of a body falling freely in vacuum. No. 2 is an experimental record obtained of the fall of a long wooden arrow, weighted by a metallic mass at its point. No. 3 is the record of the fall of a square surface (0.0225 cm. sq.) pulled by a weight of 800 grams. No. 4 is the record of a triangular surface of the same area as the preceding, pulled by the same weight. The lowest curve in Fig. 3 is the record of the tuning-fork.

Messrs. Cailletet and Colardeau have also investigated whether the resistance encountered by a flat surface moving through the air is proportional to this area. For that purpose they employed two square surfaces the areas of which were in the ratio of 1 to 2, and pulled by weights of like proportion. The corrected time of fall was respectively 6.92 and 6.96 seconds, these figures being practically identical confirm the strict proportionality.

LAMP AND WIRE CALCULATIONS WITHOUT TABLES OR CURVES.

BY

E. P. Roberts

1. To determine the resistance of the lamps when candle power (c. p.) and voltage are known.

2. Given the percentage of loss to be allowed in the line, to ascertain the line resistance (*R*).

3. Given the line resistance *R*, to determine the size of wire, weight, etc.

1. Evidently, if the total c. p. and watts per c. p. be known, the total watts is their product. The current equals the total watts divided by the voltage. The resistance of the lamp equals the p. d. (*at lamp*) divided by the current. All that is needed is to apply Ohm's law.

$$\left.\begin{array}{l}\text{Total c. p.} = a.\\ \text{Watts per c. p.} = b.\end{array}\right\}\text{Total watts} = ab.$$

$$\text{p. d. at lamp} = V;\ \text{therefore current } (C) = \frac{ab}{V}.$$

$$\text{Lamp } R = \frac{V}{C} = \frac{C \times V}{ab}.$$

Example.—Given 200, 16 c. p., 3.4 watts per c. p., 100 volt lamps: To find the *C.* and *R.*

$$\textit{Ans.}—C = \frac{200 \times 16 \times 3.4}{100} = 108.8 \text{ amperes};$$

$$R = \frac{100}{108.8} = .92 \text{ ohms.}$$

2. This is evidently a matter of percentage. In the example above, if 10 per cent. of the *total* energy given to the line is to be allowed for line loss, and the loss is to be calculated on the basis of 200 in use, (probably 250 to 300 connected), then the line resistance will be

$$\frac{.92 \times 100}{90} \times .1 = .102 \text{ ohm.}$$

If the line considered be 800 feet total length then the *R* per 1,000 feet is *R* of 800 feet + *R* of $\frac{1}{4}$ of 800 feet = .102 + .025 = .127. Or, taken as an example in percentage, $\frac{.102}{80} \times 100 = .127$ ohm.

3. The next point is to determine the size of wire, its weight, etc. The writer would recall the following facts:

a.—The B. and S. gauge is based upon the law of geometrical progression.

b.—No. 10 B. and S. gauge wire is .1 inch in diameter and measures one ohm per 1,000 feet.

The factor connecting the area of cross-section, and consequently the resistance and weight, of one size of wire with the size next on the scale is $\frac{4}{5}$ or $1\frac{1}{4}$, according to whether ascending or descending. Therefore the *R* of any wire smaller than No. 10 is $1\frac{1}{4}$ (1.25) raised to a power equal to the difference between No. 10 and the size desired; and the *R* of any size smaller is $\frac{4}{5}$ (.8) treated in the same way.

For example: No. 14 wire = $1\frac{1}{4}$ to the fourth power = 2.44 ohms per 1,000 feet. According to the table the *R* of No. 14 = 2.59. Greater accuracy could be obtained by using 1.26, or, if larger than No. 10 wire, .79.

To take an application to a larger size, consider No. 6. The difference between 10 and 6 = 4; therefore .8 to the fourth power = .409; the tabulated *R* = .395, evidently practically accurate. Whatever allowance is deemed advisable can be made for conductivity; usually it will be a matter of nearest size without considering 2 or 3 per cent. loss due to 97 or 98 per cent. conductivity. If it so happen that a table of logarithms be accessible, then calculations are assisted by noting that as the *R* of No. 10 wire is one ohm per 1,000 feet, its logarithm = 0 and that the logarithm increases by .1 for each number higher than 10 and decreases by .1 for each number smaller. If, therefore, the *R* of No. 5 wire be desired, the logarithm of the *R* will be 0 less .5 = 1.5, *R* = .317 ohm per 1,000 feet. If the wire be No. 18 the logarithm will be 0 + 8, giving 6.31 ohms.

Evidently an order could now be sent to "Express at once — feet No. — wire," but possibly the investigation involves a question of weight. The weight of No. 10 wire is 31.37 lbs. per 1,000 feet, (approx. 33$\frac{1}{3}$ per cent. or $\frac{1}{3}$); it is perhaps easier to remember that No. 5 weighs 100 lbs. per 1,000 feet. If preferred, an effort can be made to remember that one cubic foot of copper weighs 555 lbs. or that one mil. foot weighs .003 lb. As the diamter of No. 10 wire is .1 inch and as the resistance is inversely proportional to area, or weight, it is evident that the weight can be readily calculated. For most sizes of wire used in aerial work the insulation weighs approximately 20 per cent. of the total and therefore 25 per cent. must be added to the weight calculated for bare wire. Then by adding 3 to 5 per cent. for slack and error in measurements and an additional percentage if the size be not No. 10 or near thereto (see table at end of article) the investigator is in a condition to telegraph for the pounds required, or to make an estimate of cost of wire. That is, provided he can remember:

1. Ohm's law, and can use it.
2. That lamps are made of from 3 to 4 watts per c. p.—safe average 3.5.
3. That No. 10 wire measures 1 ohm per 1,000 feet, and is .1 inch in diam. and weighs about 33 lbs. per 1,000 feet.
4. The $\frac{4}{5}$ or $1\frac{1}{4}$ ratio law of B. & S. gauge.

B. & S. G.	*R.* of pure copper. Ohms per 1,000 feet	*R.* obtained by raising 1.26 or .79 to power.	per cent. of error,	*R.* by log. tables.
2	.156	.152	7	.158
4	.249	.242	5	.251
6	.395	.389	3.5	.398
8	.629	.624	1.7	.631
10	1.	1.	...	1.
12	1.590	1.59	1.9	1.585
14	2.591	2.52	5.8	2.512
16	4.019	4.13	6	3.982

The question of carrying capacity seldom enters lamp wiring calculations, as wire large enough for the drop is usually safe to use. No. 10 will carry safely 20 amperes and other sizes, between the limits used for aerial lines, about in proportion to cross-section; small sizes will carry more in proportion than large ones but it is well not to approach the limit in any case especially for interior work, because of safety in fusing.

Of course any man who neglects to use tables, curves, slide-rules and other conveniences of a like nature when they are accessible, is foolish, but sometimes it will happen that a calculation is desirable and the usual conveniences are not obtainable. In such cases a knowledge of *principle* is essential, and if to the same be added the remembrance of a few fundamental constants there will almost surely come a time when the trouble taken to add to one's stock of permanent and personal information will be far more than repaid.

APPARATUS FOR DEMONSTRATING CURVES OF ELECTRIC CURRENT FLOW IN CONDUCTORS UNDER DIFFERENT CONDITIONS.[1]

THIS apparatus, due to Dr. Frolich, of Messrs. Siemens & Halske, of Berlin, was exhibited at the Frankfort Exhibition and excited so much interest at the time, that Messrs. Siemens Bros. obtained the loan of it for the late Crystal Palace Exhibition, where it was shown in the Pompeian House.

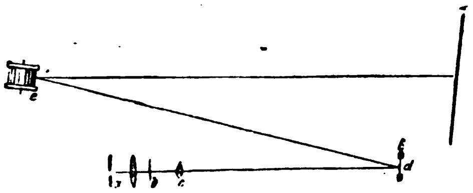


FIG. 2.

It is well known that the flow of an electric current along a circuit, or the value which the current has at any instant, is varied according to the nature of that circuit, and it is to demonstrate this curve of flow under different conditions that the apparatus to be described was constructed.

To this end the light from an arc lamp *a*, Fig. 2, is passed through a lens and a small opening in the screen *b* and is concentrated by the lens *c* upon a small mirror *d* fixed between the centre and the periphery of a telephone membrane *t*. It is therefrom reflected on to a series of revolving mirrors *e*, and is finally thrown upon a transparent screen *f*, where its vagaries can be carefully analyzed and photographed if desired.

Fig. 1 is an elevation of the small Siemens alternator used in these experiments for producing alternate currents, and for giving intermittent currents. The mirrors *e*, of which there are twelve, are arranged on a vertical axis which carries above the mirrors a worm-wheel gearing with the worm *w* on the alternator shaft. Each mirror is provided with three screws, so that it can be adjusted with great exactness in order to bring it parallel with the axis, and to insure that the mirrors make equal angles with one another. The ratio of gear between mirrors and alternator is 1.24. The alternator has twelve poles; so that it gives six complete periods per revolution, or 144 complete periods per revolution of the mirrors. For alternate currents the usual collector rings are supplied, but for intermittent currents a small 12-part air commutator *c* is provided, and by means of a small switch *s* on the end of the spindle the alternator can be conveniently made to give either intermittent or alternate currents. The combination is driven from the Siemens motor by means of a strap passing over the pulley *p*. Many interesting acoustic experiments can be performed with this apparatus but we must confine ourselves to the electrical.

Electrical Experiments.—These are divided into two groups, namely, those obtained by the use of intermittent currents and alternate currents.

(*a*) *Intermittent Currents.*—The following experiments were so arranged that one end of the telephone circuit was alternately connected to the one pole of the battery and to the other pole, which was connected to earth. In this manner the telephone circuit was alternately short-circuited on itself.

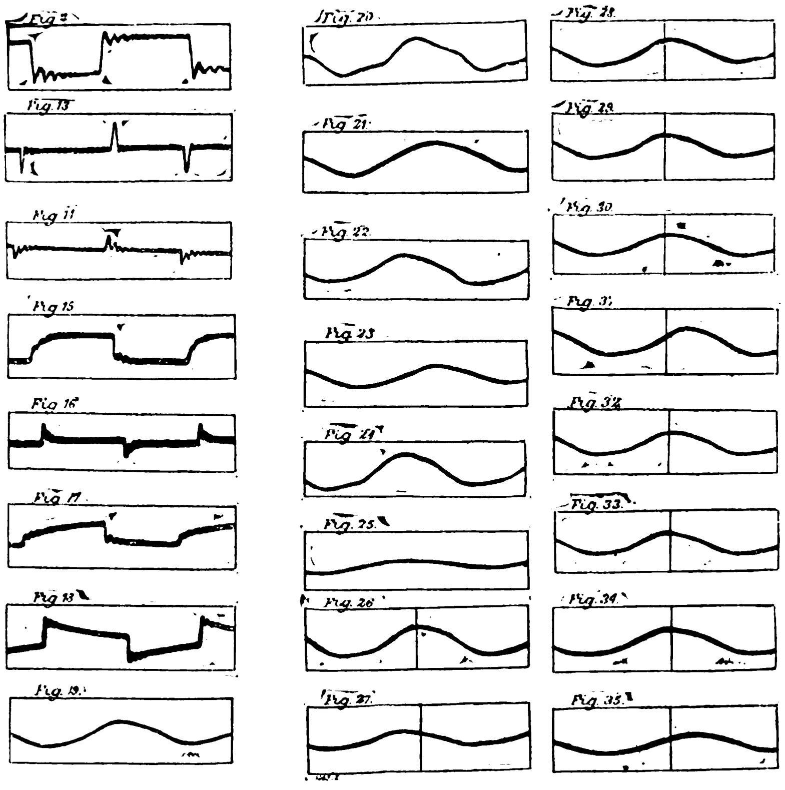
Experiments with ordinary resistance coils wound bifilarly, gave curves as shown in Fig. 4. This curve shows distinctly a slight rounding off at the corners, thereby indicating the presence to a slight degree of self-induction.

Fig. 13 shows the curve of current when a condenser is placed in the external circuit, the charge and discharge being clearly shown. Fig. 14 is very interesting, representing as it does the flow of current when a resistance of 470 ohms was placed in series with the condenser. One sees how strongly the current curve is modified by the introduction of resistance. With an ordinary reflecting galvanometer this difference would be unnoticed.

Experiments with an induction coil so arranged that the core, which consisted of a bundle of iron wires, could be removed at will, are full of interest. The two windings are precisely similar and consisted of 4,900 turns of wire, the resistance of each being 200 ohms.

Fig. 15 shows the curve of current in the primary winding with core removed, whilst the secondary current is shown in Fig. 16. In this case the primary current attains its maximum quickly whilst the induced secondary changes as quickly as did the current in the case of the condenser without resistance, Fig. 13.

Figs. 17 and 18 represent the primary and secondary respectively, with iron core in position. The effect of the core is very marked. The primary current gradually attains its maximum on making the battery current. By breaking the battery current and short-circuiting the primary coil on itself the current gradually falls to zero. The secondary current does not, as in the case without core, suddenly fall away, but as one would expect, it gradually falls to zero. In these experiments the time of a complete impulse was from $\frac{1}{10}$ to $\frac{1}{30}$ second.



CURVES OF ELECTRIC CURRENT FLOW IN CONDUCTORS UNDER DIFFERENT CONDITIONS.

(*b*) *Alternate Currents.*—If the external circuit is free from self-induction the resulting curve is the true curve of the machine, and in this case is substantially a sine curve. Fig. 19 is the curve of the small alternator, Fig. 1, without iron in the armature; Fig. 20 shows the effect of introducing iron into the armature, whilst Fig. 21 is a curve obtained from a small alternator built on the principle of Gramme. The presence of iron in the small Siemens armature is very marked, and the similarity between the curve of the first machine without iron, and the Gramme pattern with iron, is very striking.

In the following experiments the small Siemens alternator was used without iron in the armature.

Figs. 22 and 23 represent an alternate current before entering an artificial cable, and after leaving the same. The amplitude is decreased one-third, thereby partly showing how it is that one is limited to distance in the case of telephony.

The effect of self-induction is very well shown in Figs. 24 and 25. Fig. 24 was taken with an external circuit of 423 ohms, and without self-induction. Fig. 25 represents the same when three electromagnets with vibrating armatures, and having the same ohmic resistance, 423 ohms, were placed in circuit. The diminution in amplitude is worthy of consideration, the same effect in the case of steady currents being only brought about by an increase in the ohmic resistance. The amplitude increases with the speed of the machine, and from this experiment the effect of electromagnets in telephone lines is easily foreseen.

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[1] Abstract from *Engineering*.

We now come to perhaps the most interesting part of this article—namely, phase difference, which plays such an important part in alternate currents. In order that this effect can be clearly shown a vertical wire was stretched before the screen and was placed at the point where the maximum ordinate occurred. Any phase difference was at once noticed on making the required change in the circuit.

The first experiment consisted in connecting up the primary of the induction coil, already mentioned, to the alternator, and so arranging matters that the telephone could be quickly changed from the primary to the secondary circuit, taking care that the vertical wire was placed on the maximum ordinate of the primary curve.

Fig. 26 shows the primary current with the vertical wire alluded to, when the core was removed. Fig 27 is the resulting secondary current. The phase difference is very marked, and roughly amounts to 53 deg.

Fig. 28 and 29 show the primary and secondary currents with iron core in position. Here the phase difference is very much reduced, and with these curves is scarcely measurable.

Phase difference is shown very strongly in the case of alternate currents in two parallel circuits—the one being free from self-induction and the other containing self-induction. In the first mentioned circuit ordinary inductionless resistances were employed, whilst parallel with it was placed the primary winding of the induction coil.

Fig. 30 gives the current in the inductionless circuit. Fig. 31 the current in the primary of the induction coil without core, and with secondary open.

Figs. 32 and 33 show the corresponding curves with iron core in position, the secondary being closed. In the first case the phase difference amounts to about 35 deg., whilst in the last it is very small indeed.

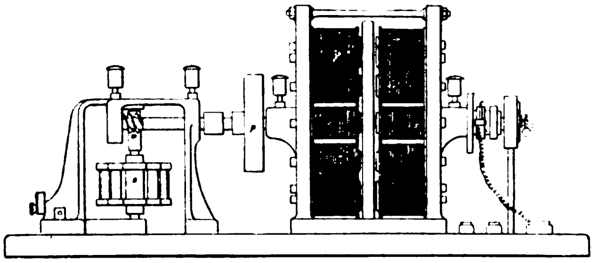

FIG. 1.

In the same manner one can find the phase difference at different points in a cable. Figs. 34 and 35 show the current before entering and after leaving the artificial cable already alluded to. Here the phase difference is about 64 deg., and the amplitude of the second curve is about .68 that of the first. With curves which are taken from circuits containing no capacity the self-induction can be calculated, and the effects of hysteresis studied.

THE GOVERNMENT TIME SYSTEM IN ITS RELATIONS, PRACTICALLY, TO RAILROAD MATTERS.[1]

BY PROF. W. A. GARDNER.

THE first great step toward the possibility of providing for exact similarity and uniformity from a single central source was taken when the railroads of the country adopted what is now known as "Standard Time," that compromise based upon the time of a few meridans, and now universally in vogue.

The people are fast concluding that about as much of their safety, and as many of their interests depend upon an accurate and uniform standard of *time*, as upon standards of area, volume or weight, and also depends on some standard which shall be *universal.*

The Government Observatory at Washington was primarily intended for this very matter, namely, to provide a time service and from its inception its work has been largely devoted to that purpose. Among the instruments of precision of which it had the custody none were of more importance than those of the chronometer class belonging to the navy. From 1844 continuously to this date, all United States vessels on going to sea have been furnished by the Observatory with their chronometers and charts.

For upwards of a half century, the Government Observatory has provided the shipping interest with the exact time. Thus the influence of that Observatory in respect to standard time is more widely established than that of any other. When the writer became connected with the Government Observatory some thirty years ago, its time work was as yet restricted to navy instruments. But shortly after the commencement of that connection he became impressed with the importance of extending this service of a standard time to make it available to transportation on land as well as to navigation. Through many years he tested all the known systems, but was compelled to devise and adapt special instruments. And his ultimate purpose was continually the assisting of railroads in having a uniform standard of time if possible.

Those sufficiently curious can follow the successive stages by reading the bureau's annual reports.

Among the roads which have for a number of years been continuously using the time standard of the Government are the following:

Richmond & Danville; Norfolk and Western; Atlantic Coast Line; Cape Fear & Yadkin Valley; Lehigh Valley; Richmond, Fredericksburg & Potomac; Georgia Central; Chicago, Burlington & Quincy; Norfolk & Southern; Chesapeake & Ohio; Charleston & South Carolina; New York, Chicago & St. Louis; Lake Erie & Western; Baltimore & Ohio; West Point & Atlanta; Illinois Central.

With this brief review of the Observatory and its work in establishing a standard time service, I pass for a moment to that part of its equipment devoted to this work. There is much confusion of idea, even lack of information on this point. Such inquiries are common, as, Where do the Government time signals come from? and, How are they sent?

There are two officers to keep the clocks correct. Observations of the stars are taken by them every night, weather permitting. As you know, all of the "time" stars have been observed so many hundreds of times that one can now know beforehand exactly the instant when any one of them should pass the line of his transit telescope to the hundreth part of a second. The accuracy of your standard time, after all, depends upon the movements of these heavenly bodies, and upon the accuracy of the observations made upon them. They are the ultimate, and the most nearly absolutely accurate standard. All human contrivances are merely compromises, and subject every instant to variations from the fixed standard of the stars.

These two observers make special observations, each upon, we will say, a single star, and with these before them they derive the exact instant of the transit relative to a sidereal clock. Next they compare the reading of this clock with that of a mean-time clock, and by the comparison ascertain exactly the error of the latter, that is, ascertain its variation from the star standard which has occurred since the last comparison. This variation they are able to measure by the chronograph and other instruments (which we cannot stop now to discuss) to hundredths of a second.

The time signals are sent out from the Government Observatory at noon, the observations having been made the night before, and the comparisons having been made in the morning as late as is practicable in order to eliminate the chance of variation between the time of closing the comparison and the time of transmitting the signals. At a few moments of twelve o'clock everything is ready for the transmission over the telegraph wires of the signals, first those signals of a preliminary or attention-calling nature, and, finally, that one which is to indicate the predetermined instant, as, for example, the instant of noon.

Now, how shall these preliminary and the final signals be transmitted?

In order to eliminate all errors due to "personal equation," the writer many years ago set about devising and perfecting some plan for obviating the intervention of the human hand at any point. These efforts culminated finally in the automatic system of transmission which is now, and has been for a long time, continuously employed with entire satisfaction. This automatic plan depends upon the introducing of a third clock in the series, namely, the transmitting clock.

The transmitting clock is caused for a few minutes in the day to indicate correct time as nearly absolutely accurately as is possible with human instruments. And during these few moments it is utilized to open and close the electrical circuits which transmit, first, the preliminary, and, ultimately, the final time signal.

The simple instrumentality which finally accomplishes the signal transmitting is a toothed wheel secured to the seconds arbor of this transmitting clock. Teeth are removed so as to cause those characteristic gaps or intervals now recognized by telegraphers universally over the United States. For three minutes prior to exact noon the impulses are transmitted at each second, with the exception of the well-known gaps or interims. From the Naval Observatory telegraphic loops extend to the main Washington office of the Western Union Telegraph Co. At the latter the signals are transferred by numerous multiple repeaters to a large number of main lines which distribute them over 300,000 miles of main and local wires throughout the United States.

From this point on it becomes merely a matter of accurate telegraphic work in order to get (at the most distant point and through the most circuitous electric routes) an entirely automatic transmission of the signals from the little wheel in that Observatory clock to receiving instruments of any sort.

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[1] Abstract of a paper read before the Association of Railway Telegraph Superintendents, Denver, Col. June 16, 1892.

So extended has the system been that it is safe to say that at noon to-day that small wheel automatically affected the armatures of 20,000 receiving instruments.

It is not our purpose to discuss at any length the various receiving instruments which have been experimented with and of which two or three sorts have been largely introduced. The two that are possibly the most widely used are known as the "Gardner" clock and the "self-winding clock." So far as concerns the reception of the synchronizing or controlling impulses, these are or may be, essentially similar. The difference lies in the motive power for the clock trains, that in the Gardner system being the one which the experience of horologists has maintained for hundreds of years, to wit, gravity, acting entirely independently of the electric current, and in the other being a battery and a motor. Each of these also has its numerous advocates. But that is a matter of interest rather to the horologist than to the one aiming to systematize the ultimate standards of comparison in obtaining correct time. Of these clocks, many hundreds are now in use upon the various lines of road, and if properly applied and cared for they furnish the most accurate of all contrivances for manifesting visually the accurate time at all periods.

The artificial compromise embodied in "standard time" renders it possible to automatically regulate each and all of many thousands of duplicate clocks scattered over vast territory. For each clock, by a slight adjustment, can be used in any section; to indicate any one of the few times belonging respectively to the geographic divisions, and duplicates can be adjusted to indicate simultaneously all of the several times.

I take the liberty of offering two or three suggestions which may provoke attention even if erroneous:

First. So far as possible all hand work should be avoided, and automatic receiving and distributing should be employed even at the most distant points. Careful tests over comparatively long periods of time have shown it practicable to transmit the signals over thousands of miles with a variation never exceeding a few tenths of a second.

Second. I suggest that after selecting the Observatory which is to be your authority you receive its signals direct throughout your whole system at least once daily instead of receiving the Observatory signals only at some central station and at another hour retransmitting them from there. After its reception each system may, for one reason or another, utilize some other hour for its special time work.

Third. I suggest that, so far as possible, use be made of automatic recorders, specially adjusted and exclusively used for recording the signals. If it be only a Morse register it is advisable to use it. With a recorder at every important point (such as a branching, distributing or repeating point) responsibility for error or failure can be located quickly and satisfactorily.

Failures or errors in the signals have been repeatedly reported to the writer at the Observatory from distant points, and the Observatory chronograph showed conclusively that at the times of the errors the signals had been sent out absolutely correctly from that point.

Fourth. I submit for consideration, in the light of your experience as telegraphers, this: Wherever possible, the use of duplex or quadruplex instruments should be avoided, and that for the receiving, repeating, and distributing of the signals, instruments should be temporarily substituted which are simple in construction, sure in operation and easily kept in adjustment.

In respect to the final or exact noon signal, this seems to me to be of importance. It must be borne in mind that this is unlike ordinary business telegraphing, for if that final signal is lost it is impossible to regain it by the methods ordinarily employed to regain a lost signal. This final impulse leaves the Observatory a full second in length, but at many distant points, to the writer's knowledge, it has, on occasions, been delayed in its commencement and sometimes prolonged more than the second; errors undoubtedly traceable to mal-adjustment of receiving and repeating instruments, and as I have sometimes thought, possibly due to the more delicately adjusted and variable instruments of the duplex and the quadruplex characters. These time signals are all going in one direction only over the wires and do not require instruments capable of using the wires in the opposite direction. And, therefore, instruments of the simplest sort can be employed for advancing them from one section to another. And a simple switch at the time-signaling period can cause the cutting out of the ordinary sets and the inserting of a time set.

Mr. Eugene F. Carpenter has resigned his position at Farmington, Me., to accept a new one as electrical engineer and superintendent for the Concord, N. H., Land & Water Power Co., which has contracted to supply Concord and vicinity with 5,000 incandescents, 200 arc lights and 600 h. p. of motors. The plan has already been outlined in our columns. The new factories of the Page Belting Co. in Concord will be equipped throughout with electric motors supplied with current by the company.

BROOKLYN EAGLE'S NEW HOUSE—A PUBLIC RECEPTION—

1842-1892.

That time-honored newspaper the *Brooklyn Daily Eagle* celebrates its jubilee year by entering into the possession and enjoyment of its superb new building, at Washington and Johnson streets. Through the invitation of Col. Wm. Hester, for the Eagle Corporation, of which he is president, some three thousand citizens visited the new quarters Wednesday afternoon, July 27, where they were handsomely entertained by music and at luncheon. The entire establishment, from roof to cellar was thrown open to the visitors, every department being in operation as usual in a daily paper office. All fortunute enough to be present were impressed by the completeness and elegance of every appointment for the work and comfort of the staff and employees. The composing-room, on the top floor of the lofty building, is a model of convenient arrangement and is equipped with the most modern forms of stands and cases. Below, the editors and reporters are found with rooms and desks resembling more those found in prosperous mercantile or banking offices than the customary dens and deal tables of editorial departments.

The executive apartments and the business offices—the latter on the ground floor—are in every respect equal in design and finish to the present high standard of the best business and office buildings in New York or elsewhere.

Col. Hester and a number of the staff gave up the afternoon to gracious attentions to their visitors, all of whom will recall with pleasure the hour spent under the *Eagle's* roof, and wish they might live to enjoy a similar pleasure when the centennial anniversary of that excellent journal arrives.

Society and Club Notes.

TORONTO CONVENTION OF EDISON ILLUMINATING COMPANIES.

All the arrangements have now been perfected for the annual convention of the Association of Edison Illuminating Companies, to be held at Toronto, Can., on August 9 and 10. Secretary W. J. Jenks states that the headquarters will be established at the Rossin House, with rooms at $3 and $4 per day. The meetings will also be held there.

The Toronto Incandescent Electric Light Company (Frederick Nicholls, manager and secretary) has arranged an attractive programme for the entertainment of the delegates in the form of a moonlight sail on Toronto Bay, calling at Toronto Island, where refreshments will be provided for the delegates at Hanlan's Hotel, the home of the ex-champion oarsman; also a drive in carriages around the principal parts of the city.

It is probable that a trip to Peterborough, where the shops of the Canadian Department are located, may be made by those in attendance at the convention who may desire to visit them. It is feasible to make such an excursion in one day, leaving Toronto at 9 a. m., arriving in Peterborough at 11.45; taking lunch at the Oriental and spending the afternoon at the Works; leaving at 5.45 and arriving in Toronto at 8.10 p. m. This trip will probably be made on Thursday, August 11. There is every prospect of a large attendance and of some excellent work. The Edison Association has always been noted for the way it sticks to work while the convention lasts. Some little curiosity has been felt as to whether the association will take any action governing its future under the new conditions that affect its parent company; but there are many who see no good reason why the association should not maintain its independent existence.

The present officers of the association are: President, John I. Beggs; vice-president, C. L. Edgar; secretary, W. J. Jenks; treasurer, Wilson S. Howell; executive committee, A. L. Smith, C. P. Gilbert, T. P. Merritt, H. J. Smith.

THE SOUTHERN BELL TELEPHONE CO.—MEETING OF SUPERINTENDENTS AND MANAGERS.

A meeting of the superintendents and managers of the Southern Bell Telephone and Telegraph Company was held last week, on the 13th and 14th inst., at Asheville, N. C.

This meeting was the first of exactly the kind that has been held in the history of the company. The object was to impart some instruction upon details of the business and service common to all the exchanges, large and small; to enable the managers from remote points to become acquainted with each other and to promote a feeling of common interest and ambition. Messrs. Thos. D. Lockwood and Geo. K. Thompson, of the electrical staff of The American Bell Telephone Company, were present, and gave instructive and entertaining lectures. Papers were also read by several of the Southern Bell force.

The Southern Bell Company's officials in attendance were: D. I. Carson, general superintendent, New York; D. G. Black, special agent, New York; J. A. Wotton, electrician, Atlanta, Ga.; C. E. McCluer, superintendent first district, Richmond, Va.; W. C. Hutt, foreman of construction first district, Richmond, Va.; C. P. McCluer, district inspector, Richmond, Va.; J. D. Easterlin, superintendent second district, Atlanta, Ga.; J. A. Owen, foreman of construction second district, Atlanta, Ga.; I. O. Utsey, district inspector, Atlanta, Ga.

There were also in attendance the managers of nearly all the exchanges of the company.

About twelve hours were spent in session work, consisting of the reading of papers and discussions, together with instructive addresses by experts, on Wednesday and Thursday; after which came a drive around the beautiful suburbs of Asheville, and a dinner in the evening, at which speeches were made by Mr. Lockwood, Supt. McCluer, Supt. Easterlin and others. The banquet was festive and memorable in every sense. Mr. Lockwood who began with some weighty and valuable remarks on practical and business topics proceeded to let loose a large installment of his quips and quiddities as a little relaxation after the serious talk of two days, and to the manifest enjoyment of the company. Messrs. McCluer and Easterlin exhibited no less acumen and good sense as after-dinner talkers than they have always shown as practical telephonists.

Secretary and General Superintendent Carson presided over the meetings with his accustomed suavity and dignity, and as chairman at the dinner, amply fulfilled the proper function of drawing out the best and brightest from the speakers of the evening.

DR. ELISHA GRAY ON THE ELECTRICAL CONGRESS.

MR. BONNEY, who has charge of the various congresses connected with the World's Fair of 1893, has received the following interesting letter from Dr. Elisha Gray, chairman of the electrical congress, who is now in London:

(Copy).

LONDON, July 14, 1892.

My dear MR. BONNEY:

I promised to drop you a line from this side and tell you how things seemed to be shaping for our electrical congress to be held in Chicago next year. I have had an extended trip on the Continent, including Italy, Greece, Turkey, Austria, France, etc. Of course, there is not much to be expected from those far off countries in the matter of electricity, but everywhere I found preparations of some kind going on for the great Fair. Casts were being made of the celebrated pieces of statuary in Rome, Athens, Constantinople and other cities.

I passed hurriedly through England and France to join my family in Rome, leaving the work to be done on my return trip. I have had a warm reception in every city, but notably in Vienna, Paris and London, where many electricians reside and where I am best known.

I was presented to the scientific societies in France, which gave me an opportunity to present the matter of electrical congress in the most favorable way. While France and Austria were very cordial in their support, and did everything they could, they are still not able to give that support, in numbers at least, that England will. I find the scientific people here very cordial and quite in earnest, and anxious to make the World's Congress of Electricians the most notable ever held. An active branch of the advisory council will be organized here to co-operate with the American branch in organizing the congress.

One word about the time. It will be fatal to the congress, so far as Europe is concerned, to hold it earlier than the last week in August, but preferably the first week in September. Many of the schools do not close till the last of July, and then the British Association meets early in August this year, and will undoubtedly meet early as possible next year so as to get over to Chicago by the latter part of August—if we accommodate them in the matter of time. Very many of the best electricians here are engaged in college and university work, and it would be very bad policy not to accommodate them. So, if possible, make it the first week in September, but not earlier than the last week in August.

Sincerely yours,
ELISHA GRAY,
Chairman World's Electrical Congress Committee.

NEW YORK ELECTRIC CLUB.

AT a meeting of the board of managers, held at the club-house, July 21, the following were elected members: J. F. Hughes, D. A. Patten, Alex. H. Bauer, H. J. Stanbaugh, J. H. Enholm, Harry S. Marlor, W. S. Hine, Edward Peck, Leonard F. Requa, J. H. Long, George E. Kent, A. G. Greenburg, F. H. Leonard, Jr., and E. W. Seymour.

Letters to the Editor.

IS ACCUMULATOR TRACTION A FAILURE?

I SEE by the papers that there are to be attempts made to revive on the Second Avenue Railway, of this city, and on the Elevated Road in Brooklyn, electric traction by means of the secondary battery.

Remembering the effect that every unsuccessful experiment has on would-be investors in electrical enterprises, and considering the fact that the history of traction, by means of accumulators, is that of one financial disaster after another, is there not some electrical paper that will show the true state of that subject and confer a lasting benefit on would-be investors?

I do not mean this letter for publication, but hope that you may be induced to at least print a list of the disastrous failures attending former attempts in this direction. You can do electrical enterprise no greater service.

ALBERT STETSON.

ROOM 61 DREXEL BUILDING, CITY,
July 25, 1892.

TRANSFORMER TESTS BY DR. J. HOPKINSON.

I HAVE just read your editorial upon the recent tests of Westinghouse transformers by Dr. John Hopkinson. You call especial attention to the high efficiency at light load which is shown in this test. This point can be emphasized even more strongly, as an error is made in the report of Dr. Hopkinson in stating that the efficiency at quarter load is 84.7 per cent. This figure, upon examination of the tests, is found to correspond to the efficiency of the two transformers taken together, so that the efficiency of the single transformer is something over 92 per cent. at quarter load. I have just been informed of a letter from Dr. Hopkinson to the company in London, for whom the test was made, calling attention to this oversight in the report.

I have calculated from Dr. Hopkinson's data the efficiencies for smaller loads than those for which figures are given in the report. The iron loss of 114 watts is practically the same for all loads, and the copper loss at one-tenth load and less does not exceed one watt. When the output is 650 watts, or one-tenth of the capacity of the converter, the energy delivered to the converter is 765 watts, and the efficiency is therefore 85 per cent. At one per cent. of full load the efficiency exceeds 36 per cent., and when only one 50-watt lamp is supplied by the transformer, which is capable of carrying 130 such lamps, the efficiency is over 30 per cent.

There is a very great satisfaction in noting that an American transformer is found to show such favorable results after a most searching and impartial test by an English electrician of such high reputation as Dr. Hopkinson.

CHAS. F. SCOTT,
Westinghouse Electric and Mfg. Co.

PITTSBURGH, PA., July 22, 1892.

STORAGE BATTERIES IN RAILWAY WORK.

I HAVE read with the greatest interest the article of Mr. Macrae, in THE ELECTRICAL ENGINEER of June 29, entitled "The Storage Battery in Railway Work." The example chosen allows him to defend successfully a proposition which merits serious examination and judicious study. By all means possible electric central stations ought to seek to utilize completely their motive power every day of the year and every hour of the day, imitating in this respect the wise example set them by the gas works. To sleep all the summer day under canvas covers, according to the picturesque expression of Mr. Macrae, is for them a harmful rest.

As regards the conclusions given at the end of the article referred to, I may be permitted to recall the fact that I have, quite some time ago, promulgated the same idea. By referring to Vol. XX, page 492, 1886, of *La Lumière Electrique*, you will read the following lines in the course of an article on the Metropolitan Road of Paris: "The use of storage batteries seems much more likely to be indicated on long railway lines passing in proximity to natural sources of power." And then follow several examples for France.

As on this point I am in perfect accord with Mr. Macrae, I would be obliged to you for publishing this short note in your esteemed journal.

EMILE DIEUDONNÉ,
Editor *L'Electricien*.

PARIS July 15, 1892.

ST. JOHNS SINGED; NOT ST. JOHN.

I BEG to state for the information of the electrical trade generally and to many of our friends from whom we have received inquiries, condolences, etc., that the recent destructive fire which occurred in St. Johns, Newfoundland, was at an entirely different place from St. John, New Brunswick, where our electrical plant is located; and that instead of being burned out, we are now making additions to the building in order to accommodate machinery to supply an increasing business.

A. A. KNUDSON,
Electrician.

THE CONSOLIDATED ELECTRIC CO., LTD., OF ST. JOHN, N. B.
New York, July 28, 1892.

THE VACUUM LIGHTNING ARRESTER.

I SEE on page 50 of your last issue, an inquiry that I can answer if no other response is forthcoming. A lightning protector consisting of a partially exhausted globe, with two electrodes sealed in it opposite to each other, one connected to line and the other to ground, was invented by the late Mr. C. F. Varley about twenty years ago I believe, and is still in use in connection with submarine cables under the name of the Varley protector. It is credited with being very sensitive, but formerly had the disadvantage that occasionally—I presume from imperfect sealing before the days of electric lamps—the vacuum would disappear.

A. E. KENNELLY.

EDISON LABORATORY, ORANGE, N. J.

[We have received other communications in the response to our inquiry. EDS. E. E.]

THE MECHANICAL EXHAUSTION OF INCANDESCENT LAMP BULBS.

THERE appeared in the issue of your esteemed journal of July 20th an article under the signature of J. W. Packard upon the subject of "Exhausting Incandescent Lamps by Means of Mercury Pumps." We have carefully perused this article and desire to call your attention, as well as that of the public generally, to several statements which occur therein.

In the first place the manner in which Mr. Packard summarizes from an article by Prof. Thomas, of the Ohio State University, is noteworthy.

This will become evident from the two following paragraphs, the first quoted from Prof. Thomas's article which appeared in THE ELECTRICAL ENGINEER of July 13th, and the other from the article of Mr. Packard, above referred to. On page 39, column 2d, of your July 13 issue appears the following statement by Prof. Thomas:

> When the sorting and grading were satisfactorily completed and the letters on the lamp bases examined, it was remarked that the two lots which were least blackened were of the makes which are advertised as exhausted by mechanical pumps. That they should both be so much alike in blackening, and both only one-half as much blackened as the least blackened of the mercurial exhausted lamps, is, to say the least, worthy of notice. It is, of course, not established that the observed freedom from blackening is due to the absence of mercury vapor in the lamps, as the makers claim, but if investigation should establish the claim the mercury pump will probably become once more a laboratory instrument.

On page 57, column 2d, of your July 20th issue appears the following statement by Mr. Packard:

> In the recent test by Prof. Thomas at the Ohio State University, the "Packard" lamps, which are exhausted by the mercurial process, showed considerably less blackening than any of the other makes, among which was the "Beacon," which is exhausted by the mechanical process.

We leave it to your judgment, and to that of the public generally, whether Mr. Packard has correctly interpreted Prof. Thomas.

In the second place, in estimating the cost of exhausting lamps by mercurial pumps, Mr. Packard fails to take into account at least three very important items, which, when added to his column, will materially increase the sum total.

These items consist of: First, the power required to run the air pumps by which the mercury pumps are operated. Second, the electrical energy consumed in incandescing the filaments during exhaustion; and, third, the rent for the large floor space necessary for the mercurial pump plant.

Furthermore, Mr. Packard has given very low figures for the expense items which he has mentioned, so low indeed that it is very doubtful if they could be attained under the most favorable circumstances.

It is incontestable that lamps can be more economically exhausted on our metallic pump than by mercury, but it is not alone in the saving of expense in the pumping department that our metallic vacuum pump is of the greatest advantage.

We consider that the superior quality of lamps, which is largely due to our method of exhausting, is of more consequence to us as manufacturers and to the public generally than the mere saving of a few cents per lamp in the cost of manufacture.

The standard quality of our lamp, which the public is rapidly coming to appreciate, ought to be taken as sufficient proof of the above statement.

The difficulty with which Mr. Packard invests the detection of leaky lamps, among the large number which we simultaneously exhaust, is purely imaginary, since our improved appliances render such detection an easy matter. In addition, the improved mechanical construction of our lamps renders leaks of rare occurrence.

It should also be borne in mind that the amount of carbonaceous vapor which is left in our lamps is much less than the mercurial vapor remaining in those exhausted by mercurial pumps.

This trace of carbonaceous vapor, small as it is, disappears on burning the lamp, leaving a practically absolute vacuum, while the mercurial vapor exercises its injurious effects throughout the life of the lamp, being the most potent cause of blackening, since it acts as a conveyer for the transmission of minute particles of carbon from the filament to the interior wall of the bulb.

BEACON VACUUM PUMP AND ELECTRICAL COMPANY.

BOSTON, July 26, 1892.

Literature.

Die elektrische Beleuchtung industrieller Anlagen, etc., für Nicht-Elektrotechniker. By H. Blessinger. *Kiel and Leipzig,* 1892. Lipsius & Tischer. 140 pp. 6¼ x 9¼ inches. Paper. Price, $1.

THIS is a short treatise on electric lighting, giving the description of the principal types of apparatus now in use in Germany. An appendix gives very complete information as regards dimensions, cost, etc., of the principal German machines, and also full information regarding the Hagen accumulator. We are hardly prepared to acknowledge that the work is well adapted for non-electricians, as the title implies.

INDIVIDUAL SELECTION OF ELECTRICAL OBJECTS.[1]

BY S. S. BOGART.

THE application of a selector to any circuit to reach any of the objects desired and the necessity for such a device is doubtless as apparent to you all as is the application of the current to telegraph, lighting and power. In the individual call-bell circuit we have a combination of electrical impulses on a transmitter (or sent by an ordinary Morse key) and selector shaft that correspond with each other. Any other than the combination for that instrument throws in a false combination, upsets the pawls and restores the selector's sector to zero. This principle applied to all the other selectors on the circuit acts in a like manner. The call-bell set consists of a key, transmitter, relay, sounder, answer-back and bell. When the combination has properly completed its phase the answer-back is vitalized and it automatically transmits the assurance back over the wire that the object has been reached and the bell is ringing. The sounder is always in circuit, except, when the bell is ringing, then all of the battery is transferred to the bell. But three cells of ordinary Callaud or gravity battery are necessary for the entire circuit. The advantages of this system in saving time in calling offices has been carefully gone over, and it is an undisputed fact that upwards of one-third of the time is spent in calling. The greater the number of wires the more difficult the problem of raising the one or two operators at some points. As we increase the number of wires on the poles, we increase the cross-fire or induction and escape When the relay adjustments change to such an extent as to affect the sounder, the selector will work so long as the armature of the relay moves to its contacts.

In connection with the use of arc lights, the selector system affords a simple and effectual means of starting and extinguishing lights at various hours upon the same circuit. Incandescent circuits and those used for the transmission of power are equally subject to the control of the "combination selector," and in all branches of lighting and power work the system may be applied to advantage. The automatic attachment both insures safety of operation and announces to the transmitting point the completion of the desired work, while the economy resulting from its use on circuits of wide extent of great activity will be an important consideration to every company employing electric lights or power.

The use of these instruments on the police and fire circuits of cities enables an alarm to be confined to such posts or stations as are at the moment required, instead of arousing the entire department, as is generally the case. The call may be limited to a single station, or to a group of them, or to a whole district, according to the "combinations" employed.

In "Village and Town" telephone exchanges, and upon long-distance and all private lines, the application of these selectors will insure complete privacy by the exclusion of all intermediate telephones. In circuits of minor importance the central office may be entirely dispensed with, each subscriber being supplied with his own combination and those of the others upon the same circuit. This system permits calls to pass noiselessly through intermediate telephones, thus avoiding the vexatious ringing of all bells which now occurs when one subscriber sends a signal to another. The fact that no message will be audible to any subscriber other than the one immediately interested, opens what is practically a new field for the development of the telephone.

While for obvious reasons, it is not convenient to discuss in detail the use to which this system is now applied in connection with military and other government service, it may be pointed out that it (1) gives at any moment to headquarters, or other proper authority the control of the line; (2) allows confidential intercourse between any two points on a circuit without including intermediate stations; (3) gives to the commander of a battery of guns or torpedoes the faculty of discharging at will any one weapon upon a circuit without danger of affecting the others, thus dispensing with the necessity of having a separate wire for each individual weapon; (4) places in the hands of headquarters or its delegates the exclusive power of effecting any electrical circuit, by giving them the means of changing the combinations of the various stations at pleasure, by which no station can be actuated except by one familiar with the respective "combination."

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[1] Abstract of a paper read at the meeting of the Railway Telegraph Superintendents, Denver, Col., June 16, 1892.

A more recent connection and one that is received with marked favor by leading railroad men is its application to the Leonard interlocking block signal and the Leonard train order signal. In the former it enables us to use a wire for other than blocking trains, thus saving a duplication of wires. In the latter the train dispatcher is master of the situation, and controls as many signals as he desires from his table; and receives assurance of the fact from the return signal that the object sought has been attained.

CONDENSING WITH TRIPLE-EXPANSION ENGINES—A CORRECTION.

I FIND in my article a typograpical error, which should be corrected. The Kuhn engine (page 79) has a low-pressure cylinder diameter of 48 inches, not 78 inches. Further, the capacity of the Van Vleck engine is 600 to 800 h. p., not 500 to 800 h. p.

E. EGGER.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

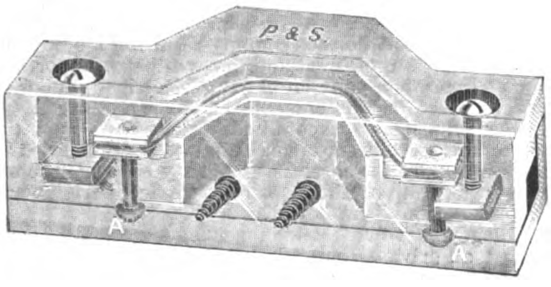
Advertising tells, like hot weather, and in spite of it.

THE BEACON VACUUM PUMP AND ELECTRICAL CO. IN CANADA.

MR. H. S. KALISKE, business manager, and Mr. W. E. Nickerson have recently visited Ottawa, Ont., on a prospecting tour, with a view to establishing an electrical factory in the dominion, and preferably in Ottawa. The Beacon Vacuum Pump and Electrical Company, after a business of one year in the manufacture of their mechanically exhausted lamps, are contemplating the establishment of several factories in various parts of the continent. Owing to tariff restrictions they must manufacture in Canada in order to avail themselves of the markets in British America for their lamps. It is significant to observe the reaching out into new fields by this enterprising company.

THE PASS & SEYMOUR COVERED MOTOR CUT-OUT.

AMONG the ingenious and useful specialties recently introduced by Messrs. Pass & Seymour, of Syracuse, N. Y., is the new covered single-pole motor cut-out, shown in the accompanying illustration. This cut-out is designed for motors on power circuits, and as it has a fuse 3 inches long it is especially adapted for 500-volt circuits. The channel which encases the fuse is of such a shape as to cause the fuse to be bent at four angles, which adds to the efficiency, as it is difficult to get a fuse to arc around an angle. In order to remove the cover for the purpose of renewing the fuse it is only necessary to loosen the screws A A half a turn.



PASS & SEYMOUR COVERED MOTOR CUT-OUT.

In common with other goods manufactured by this company, the cut-out is made of highly vitrified Syracuse china.

NEW ENGLAND NOTES.

THE AMERICAN MICA COMPANY, of Boston, are calling attention in this week's issue to the large stock of mica which they always keep on hand for electrical purposes. Their office is in 620 Atlantic avenue, and they are now right amongst the electrical trade, and guarantee prompt service, best material and lowest prices.

S. C. NIGHTINGALE & CHILDS, of Boston, have recently supplied their magnesia sectional steam pipe covering to the following plants: U. S. Marine Hospital, Chelsea; the Cambridge Power House of the West End Street Railway Company, of Boston; the Lowell and Suburban Street Railway Company, Lowell, Mass.; New Haven & West Haven Street Railway Company, New Haven, Conn.; State Capital, Hartford, Conn., besides a large amount of work in mills, as much as $2,500 worth of magnesia having been used in the Arlington mills, Lawrence. In the Lowell station they also covered with magnesia in addition to the steam pipes, the steam drums, heaters, receivers, cylinder connections, and all steam heated surfaces, and in New Haven they covered the whole surface of the three Manning boilers recently installed by Westinghouse, Church, Kerr & Company.

MR. NEWTON L. SCHLOSS, of the Ries Electric Specialty Company, of Baltimore, was in Boston this week and has established a number of agencies in this territory for the Ries regulating socket, the demand for which is becoming quite large.

THE IRON GRAVITY CELL OF THE STANDARD BATTERY CO.

FOR many decades the gravity cell has held pre-eminence as the most suitable one for producing electric current for local batteries in telegraphy. When we mention gravity cell we refer directly to that which is commonly known as the "crowfoot" battery or Callaud, which is the only closed-circuit battery that has heretofore been used for the purpose referred to. It is not necessary to state that the cost of running the battery described, *i. e.*, loss of zinc, amount of care required for its attention, low potential, high internal resistance, and the same increasing as the battery diminishes in force. With the new discovery in chemical electricity made by Mr. A. P. Willoughby of Chicago, Ill., the zinc crowfoot or electrode is entirely dispensed with and an electrode of iron, under peculiar alloy treatment is substituted for the same. Among the special advantages of this discovery are the saving between the cost of iron and zinc as electrodes, and the avoidance of the cost of cleaning the crowfoot or zinc electrode, from time to time, of the corrosion that takes place in the action of the gravity battery. The iron electrodes need no care, and no cleaning; when the iron electrode is used up all that is necessary is the replacing of another electrode.

Last and not least, of the advantages is the reliable, constant current, increasing in strength gradually from month to month. This is shown by the battery which has been in practical use in telegraph work on the C. B. & Q. Railway for over seven months. The current is higher in its potential and its amperes and very much lower in its internal resistance than at any time since the batteries were set up.

A test was made by one of the most prominent professors of chemical electricity in the Northwest, which demonstrated the following: "Two of your iron gravity cells were placed on a closed circuit through 5 ohms resistance in the early part of May, and up to the present date, June 10, 1892, they have been running constantly. The internal resistance has fallen from 3.5 ohms per cell to a little less than .9 of an ohm, while the current has increased from .6 to 1.08 ampere. The internal resistance fell rapidly during the first few days, and the current increased in the same manner. The cells promise a great deal for telegraphic and similar purposes."

In corroboration of the statement made concerning the action of the battery with the C. B. & Q. R. R., the inventor refers any one to Mr. W. W. Rider, of Chicago, the superintendent of the telegraph system of the road mentioned. There are quite a number of superintendents of different telegraph systems in the United States who have been testing this battery in their own service from one to nearly three months. There are now over 40 of the superintendents of the different trunks line throughout the United States testing these batteries under their own supervision and reporting favorably on their experiments.

The simplicity of the introduction or adoption of this battery by any company is one of its most remarkable features. The iron electrode, as described, has simply to be put in place of the zinc. There is no change of cells, and no change of elements excepting the iron electrode.

The Standard Battery Company of Chicago, Ill., 324 Dearborn street, have purchased the rights and franchises of Mr. Willoughby to this discovery and will soon be prepared to fill orders for these batteries. The battery is known as the Standard Battery Company's iron gravity battery. All correspondence referring to this battery should be addressed to the company.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

VOL. XIV. AUGUST 10, 1892. No. 223.

ELECTRIC LIGHTING IN ENGLAND.

BY

H Scholey

IT was reasonably expected that last year would have seen in England a large increase in electric light generating stations, but such expectations were not realized, for outside the metropolis there was scarce any attempt to undertake a public supply of electricity.

The progress that has been made during the last twelve months has been for the most part confined to London, and here there has been a quiet but none the less remarkable development of electric lighting business. There is scarce an important street in London in which electric light cables are not already laid, and in many places a supply of electricity has been running uninterruptedly for many months. But the larger companies must make many more lamp connections before they run their stations economically; judging from appearances, however, this consummation will be soon reached.

Having regard to all circumstances, it is yet too early to expect the London companies to show much profit, and with the exception of the St. James Company only nominal dividends have been declared. There is great praise due to the electric light companies for the manner in which they have pushed on their work, but it is to be feared that some of them will have an up-hill struggle before they stand on a firm commercial foundation. They may prove scientifically the correctness of certain theories, but unfortunately it may be electric light companies will only be deemed successful in London according to the size of the dividends they may earn. Electric light companies again, like other commercial concerns, are governed solely by the law of supply and demand. At the present price of electricity, the most remunerative customers are the clubs, shops, and theatres, and it seems most probable that the companies which were formed to supply purely residential districts will not make great profits. The householder who takes the electric light knows that it costs him much more than gas; he is therefore sparing in its use. For this reason it may happen that his electric light bill is no bigger than his old gas bills; but while this is very satisfactory from the consumer's point of view, it is more than doubtful from that of the supply companies. It is difficult to obtain figures as to the increase of lamps, but it would not be an exaggeration to say that there are nearly three times as many lamps burning in London at the present moment as there were last year.

A curious fact in the extension of the electric light is that the large provincial towns have practically done nothing. The smaller towns—in some cases villages—have shown greater appreciation of the advantages of electric light. This may be in a great measure owing to the action, or rather want of action, of the municipal bodies throughout the country.

The inquiry made by the Board of Trade in 1889 into the various schemes for the electric lighting of London did much to stimulate in the minds of the public a desire for the electric light; there was then displayed great eagerness on the part of municipal bodies and joint stock companies to secure provisional orders which would enable them to start a public supply. The Board of Trade, having prominently before their minds, the burdensome results of the gas and water monopolies, encouraged municipal authorities to undertake the supply of electricity; this encouragement, together with an exaggerated notion of the value of a provisional electric light order, led many town authorities to take powers.

Since 1888 over 120 provisional orders have been granted; of these 78 are in the possession of local authorities and 37 are owned by companies. Such figures might betoken an unwonted activity, but when we come to follow them to their results, they are disappointing. For of the 78 orders obtained by municipal authorities, not one has been proceeded with; they are for the most part shelved. There are perhaps at the outside, four cases where it has been decided to build central stations. Throughout the whole of the country, there are only two central stations worked by municipal authorities, Bradford and St. Pancras, powers for which were obtained in 1882.

The work carried out by the companies under their provisional orders shows most favorably when compared with the municipal bodies, for under 37 orders 22 generating stations have been built and are working; were it not that local restrictions of an onerous nature had been imposed, the number would have been much higher. These facts on the face of them are significant, and the advocates of joint stock enterprises are at no loss for arguments in favor of electric lighting work being carried out by companies. It cannot be denied that local authorities have shown little regard to their duties under their orders, but I believe this apathy is mostly due to the fact that they never intended to supply electricity. Municipal authorities opposed companies entering their districts, because it was thought they could make a handsome bargain by offering the concession to a company, with special provisions for their own advantage. A glaring instance of this trafficking occurred recently when a provisional order was sold by a municipal authority to a company for £1,500. Electric light companies have been well tied down by Parliament, and to be forced to buy provisional orders will not enhance their future prosperity. However, it will be found perhaps that the municipal authority has entered upon a mistaken policy.

There is no doubt that the shelving of electric light orders by municipal bodies has had a most deterrent effect on the progress of electric lighting, for it is clearly shown that had these orders been in the possession of companies a good deal would have been done. At the same time there is perhaps something to be said on behalf of the municipal authorities not undertaking lighting, for it may be claimed that until quite recently there was no instance of municipal work to guide them; it is only within the last few months that the stations of the corporations of Bradford and St. Pancras were able to show a return on the money sunk.

The Board of Trade have power to revoke a provisional order, if at the end of two years from date of the order, it is found that compulsory works have not been carried out. Now, as many of these orders have been in existence two years at the end of June, 1892, a firm attitude on the part of the Board of Trade, together with the good results obtained at Bradford and St. Pancras will do much to press forward electrical matters. At the same time it is not to be expected that the Board of Trade will act hastily in the matter, for there are many district, for which provisional orders have been obtained, which could not give a fair return on an electric lighting station.

It is an open question who can best supply the electric light; certainly a municipal body with its grip of local wants, and an organized staff at its command, holds a strong position; but the danger will be in selecting a system best adapted to its requirements. The instance of Bradford successfully carrying out a system of low tension is very well as far it goes, but when they speak of supplying the whole of the town, five miles by three, with a feeder system, it seems as if there were matter for serious consideration.

On the other hand a company brings usually an accumulated experience without which no town lighting can be well carried out. To sum up, electric lighting in London may be considered to be rapidly advancing, but in the country, generally, much remains to be done before there is a good public supply.

THE BLACKENING OF INCANDESCENT LAMPS.

BY

E. E. Cary,

The recently published life tests of incandescent lamps, by Prof. Thomas of the Ohio State University, have brought prominently and disinterestedly to the notice of the electrical fraternity the wide range in the blackening of the lamps during life, even when they have not been subjected to the wide variation in voltage which occurs in many of the central stations, and with which all lamp manufacturers have to contend.

Prof. Thomas' scale of blackening runs from 10 to 100, the latter representing the most blackened lamps, and he adds in his article on page 39 of The Electrical Engineer of July 13, the following: "It was remarked that the two lots which were least blackened were of the makes which are advertised as exhausted by mechanical pumps. That they should both be so much alike in blackening, and both only one-half as much blackened as the least blackened of the mercurially exhausted lamps, is, to say the least, worthy of notice. It is, of course, not established that the observed freedom from blackening is due to the absence of mercury vapor in the lamps, as the makers claim, but if investigation should establish the claim the mercury pump will probably become once more a laboratory instrument."

Naturally Prof. Thomas does not wish to affirm that the excessive blackening in mercurially exhausted lamps is due to the presence of mercurial vapor, but does state most positively that the lamps pumped by the metallic non-mercurial process showed but one-half of the blackening of the least blackened of any of the others. As this matter is of much importance to central stations, doing away almost entirely with seconds, which have to be used about the stations, and also with the many complaints from consumers on the score of blackened lamps and diminished light, it has naturally awakened much speculation as to whether the blackening is really due to the presence of mercurial vapor or not.

Further, the question arises, Why should there be such a variation in the blackening of individual lamps exhausted by the mercurial process? The latter question is readily answered, as it has to do entirely with the construction of the filament.

In a properly constructed filament three important conditions must be fulfilled. 1. It must be as dense as possible. 2. It must be uniform. 3. It must be elastic. That is to say, should all filaments be equally dense, uniform and elastic, and treated alike during exhaustion, the blackening would not vary. The wide range in blackening shows how far lamp manufacturers are at variance.

The writer after a year's experience with the metallic non-mercurial pump, in the exhaustion of several hundred thousand lamps, feels confident that ultimately it will be proven to the satisfaction of all, that the blackening in the lamps pumped by the old process, in a great measure is due to the presence of mercurial vapor. Repeated life tests have shown that with the same kind of filaments, the blackening is invariably greater when the lamps are mercurially exhausted. The vapor of mercury never disappears even if the lamp attains a life of from 2,000 to 3,000 hours. Its nature may be changed, for, when the lamp is broken under mercury, the vapor does not condense, but a small bubble from $\frac{6}{64}$ to $\frac{10}{64}$ of an inch is always visible.

The bubble of residual carbonaceous vapor in a lamp exhausted by the metallic non-mercurial pump may vary from $\frac{3}{64}$ to $\frac{5}{64}$ of an inch in diameter but after 75 to 100 hours' burning it entirely disappears, and no trace of one is visible even with the aid of a magnifying glass. In consequence, there is attained practically a perfect vacuum and no medium exists to assist in carrying the minute particles of carbon from the filament to the inner walls of the bulb. When this medium does exist in the form of mercury vapor, it affords an easy passage for the loosened particles of the filament to the bulb.

One important matter must be borne in mind when speaking of the blackening of lamps. Ordinarily one might think that the diminution of light is entirely due to absorption by the blackened walls of the bulb, whereas in reality this accounts for but part of the loss, for the filament is reduced in mass proportional to the blackening and consequently offers an increasing resistance to the E. M. F. which latter we may assume constant. Therefore the filament itself constantly emits less and less light, which, together with the increasing absorption, rapidly destroys the value of the lamp. This will impress upon the mind that if disintegration of the filament can be stopped, the normal strength of the filament will be retained, the lamp will not blacken, but will remain bright to the eye till broken.

Since but one company has operated the metallic non-mercurial pump (though their lamps have appeared under different names), others interested have been unable to determine the matter for themselves. It is to be hoped however that disinterested tests will be made during the coming year, to prove to the satisfaction of all interested parties the causes of the great *bête-noir* of blackening.

AN EPISODE IN THE LIFE OF THE LATE CYRUS W. FIELD.

A correspondent of the London *Times* thus describes the scene on board the "Great Eastern" at the moment of the breaking of the first Atlantic cable on August 2, 1865. The cry, "The cable is gone!" produced an effect, he says, not short of consternation on every one save one man —Cyrus Field. He rushed up on deck when the fatal announcement reached his ears in the saloon, made his way through the silent despairing group astern who were gazing into the sea in which thousands of fathoms deep their hopes were buried, satisfied himself that the cable was broken beyond remedy, and then, calmly surveying his associates without a trace of agitation on his face, said, "Well, it's so. I must go down and prepare a new prospectus immediately. This thing is to be done," and stalked quietly back to his cabin, where he set to work to write out the proposals for a new cable ere the end of the other had well settled down in the Atlantic.

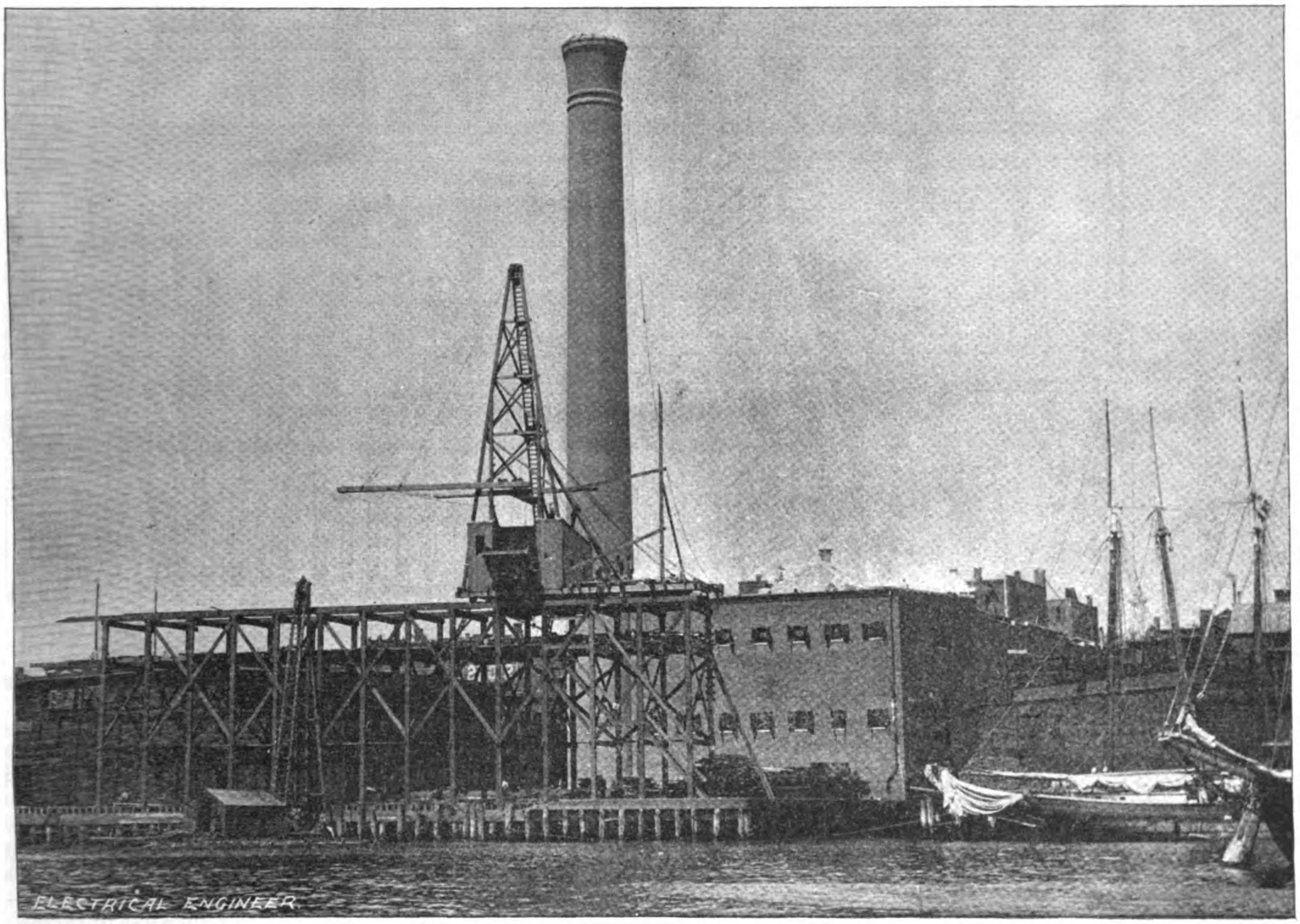
The New Station of The Edison Electric Illuminating Company of Boston.

BY

A. C. Shaw.

I.—INTRODUCTION.

IN the history of the development of electric lighting, as represented by the incandescent lamp, much of the interest is due to the fact of its immense and growing popularity. Incandescent lighting sprang into existence little more than a decade ago, when the combination of an engine and a dynamo furnishing current to a hundred incandescent lamps was looked upon as a wonderful thing, whereas, to-day, a company may commence to erect a station of from 10,000 to 25,000 h. p. without exciting any great attention except from those directly interested. Such a station it is proposed to describe in the following article, a station which may be looked upon as a model of the most advanced ideas in electrical engineering, and which has been designed after a vast amount of investigation and personal examination of the most noted central stations in this country and in Europe.

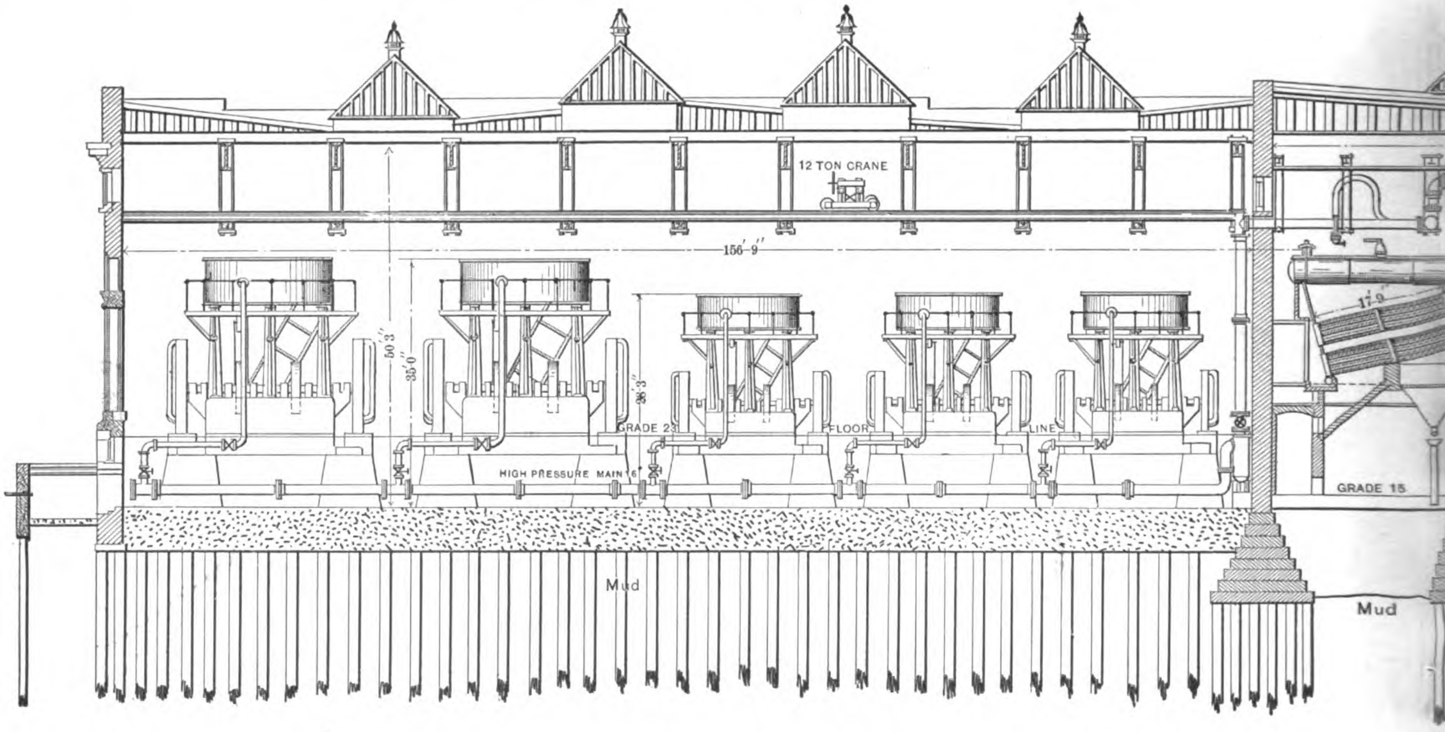


THE STATION FROM THE HARBOR.

The new Edison station in Boston is distinctly new in all its designs, as applied in this country, and it is interesting to note the different phases of central station design leading up to the plant to be described. In the first days of electric lighting, in 1881, the high speed engine of small unit was used and for many years reigned supreme. It is worthy of note that the advent of the incandescent light gave a wonderful and marked impetus to steam engineering from the necessity for an absolutely uniform speed. Gradually the size of the units was increased until many of the more modern stations are equipped with generators up to 200 h. p., two of them being driven from a 400 h. p.

engine. The Corliss engine has also come into very extensive use, though more for arc than incandescent lighting, as it can be readily seen that in an incandescent station the electrical unit can be as large as desired, whereas, in an arc station, it can never be over 50 or 60 h. p.

About four years ago the Philadelphia and New York style of Edison station was designed, and though these have given excellent satisfaction, yet the more progressive of electrical engineers have still thought that important improvements could be made, and have gradually developed the large multipolar type of generator, coupled direct to a triple-expansion condensing engine of the vertical or steam hammer type. The larger unit, with engine and generator combined, has long been in use abroad, and there are many magnificent stations of this type in all parts of Europe. In Berlin all the central stations have triple-expansion engines, and English and Scotch engineers have well sustained the reputation of this high type of engine by their unrivaled successes in ocean steam engineering, where the vertical engine is seen in perfection. In America, the economy of a station from the engineering point of view has been somewhat neglected in the past, but of late years more engineering ability has been devoted to the steam practice in electric stations, and better and more carefully designed stations are now becoming more general in this country. The new Boston Edison station may be looked upon as an example of the highest type of central station yet designed, and is therefore well worthy of a thorough description.



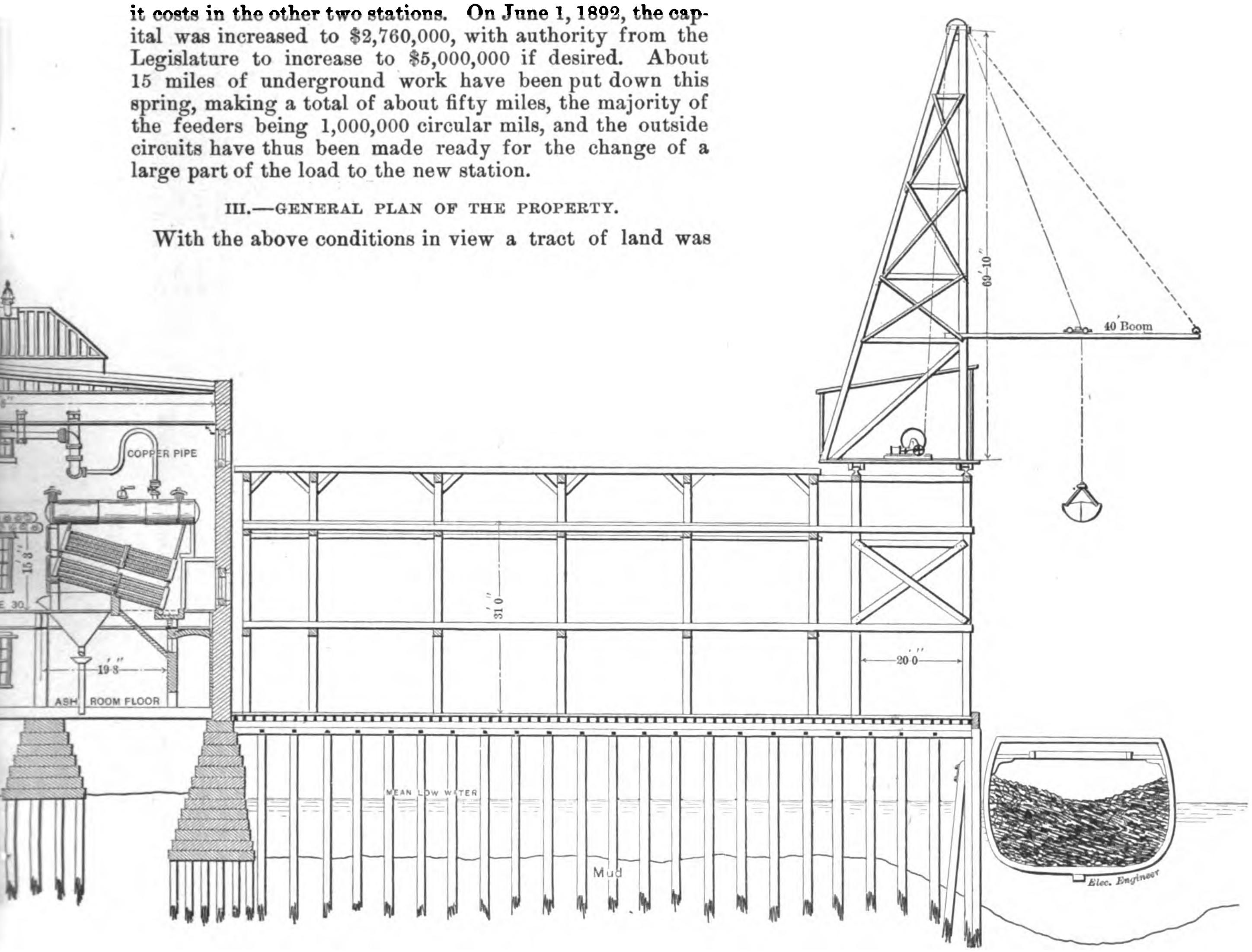
LONGITUDINAL SECTION THROUGH THE NEW STATION OF

II.—PREVIOUS HISTORY OF THE COMPANY.

A few words as to the previous history of the Edison Company, of Boston, may be found interesting at this time. The Edison Electric Illuminating Company, of Boston, was formed in the early part of 1886; and was at that time a sort of adjunct to the Bijou Theatre, which building was lighted then from a small plant in the basement of a printing office, consisting of a 75 h. p. Armington & Sims engine and two dynamos. This plant was bought by the company, which was organized with $100,000 capital. More room was soon required, and the plant was removed into an old stable occupying the site of the present boiler-room of the Head Place station. Here a station was laid out for 1,600 lights, with three engines and six old type dynamos. In the summer of 1887, the present station was erected—one story high, and having a capacity for 20 150 h. p. engines and 40 dynamos of the No. 20 type. This was probably the largest incandescent station in the country at that time, and Mr. J. H. Vail, who laid out the station, was looked upon as a very rash and visionary man. In June, 1888, the interior of the dynamo-room, with all the apparatus, was completely destroyed by fire, some fourteen dynamos being consumed at that time. Notwithstanding this, however, current was again turned onto the lines 20 hours after the fire was extinguished, some of the apparatus having been expressed from Schenectady shortly after the fire originated, and the station was made thoroughly fireproof. The capital about this time was increased by several stages to $500,000. In September, 1887, Mr. C. L. Edgar, a young electrician who had already had a wide experience in Edison central station work, was appointed general manager of the company. From that time the work has steadily increased, and the business has prospered in his hands. In 1887, about ten miles of underground work was laid down, and the overhead lines gradually abandoned. In January, 1888, the second station, on Hawkins street, was started with a capacity of 12 engines and 24 dynamos of the usual type then in use. In the fall of 1890 three more stories were added to the Head Place station and the capital increased to $2,000,000. This was not sufficient, however, to meet the growing demand for incandescent light, and in the spring of 1890 the company determined that the two existing stations were not large enough—that a large and modern station must be built, and Mr. Edgar was requested to investigate the matter thoroughly. Accordingly, in February, 1890, Mr. Edgar made a trip to Europe and examined carefully many of the important stations in that country, returning in April, 1890, with certain definite and fixed ideas as to the construction of the new station. In the spring of 1891 the property upon which their new station is situated was purchased and ground was broken on Oct. 10, 1891. Mr. Edgar had already determined to have triple-condensing engines of the vertical type, that the new station should be of one story, and that it must be situated on the water front even at the sacrifice of being at a reasonable distance from the electrical centre of distribution. The site of the new station is on Atlantic Avenue opposite the foot of Pearl Street, occupying the old historic spot of the Boston Tea Party, where the tea was thrown overboard from English ships, on December 16th, 1773, by the citizens of Boston, and though, at first sight, it may appear to be far from the centre, yet, in connection with the other two stations, by actual calculation, it is within 500 feet of the electrical centre. It is expected that in the new station steam can be made for less than one-half what it costs in the other two stations. On June 1, 1892, the capital was increased to $2,760,000, with authority from the Legislature to increase to $5,000,000 if desired. About 15 miles of underground work have been put down this spring, making a total of about fifty miles, the majority of the feeders being 1,000,000 circular mils, and the outside circuits have thus been made ready for the change of a large part of the load to the new station.

III.—GENERAL PLAN OF THE PROPERTY.

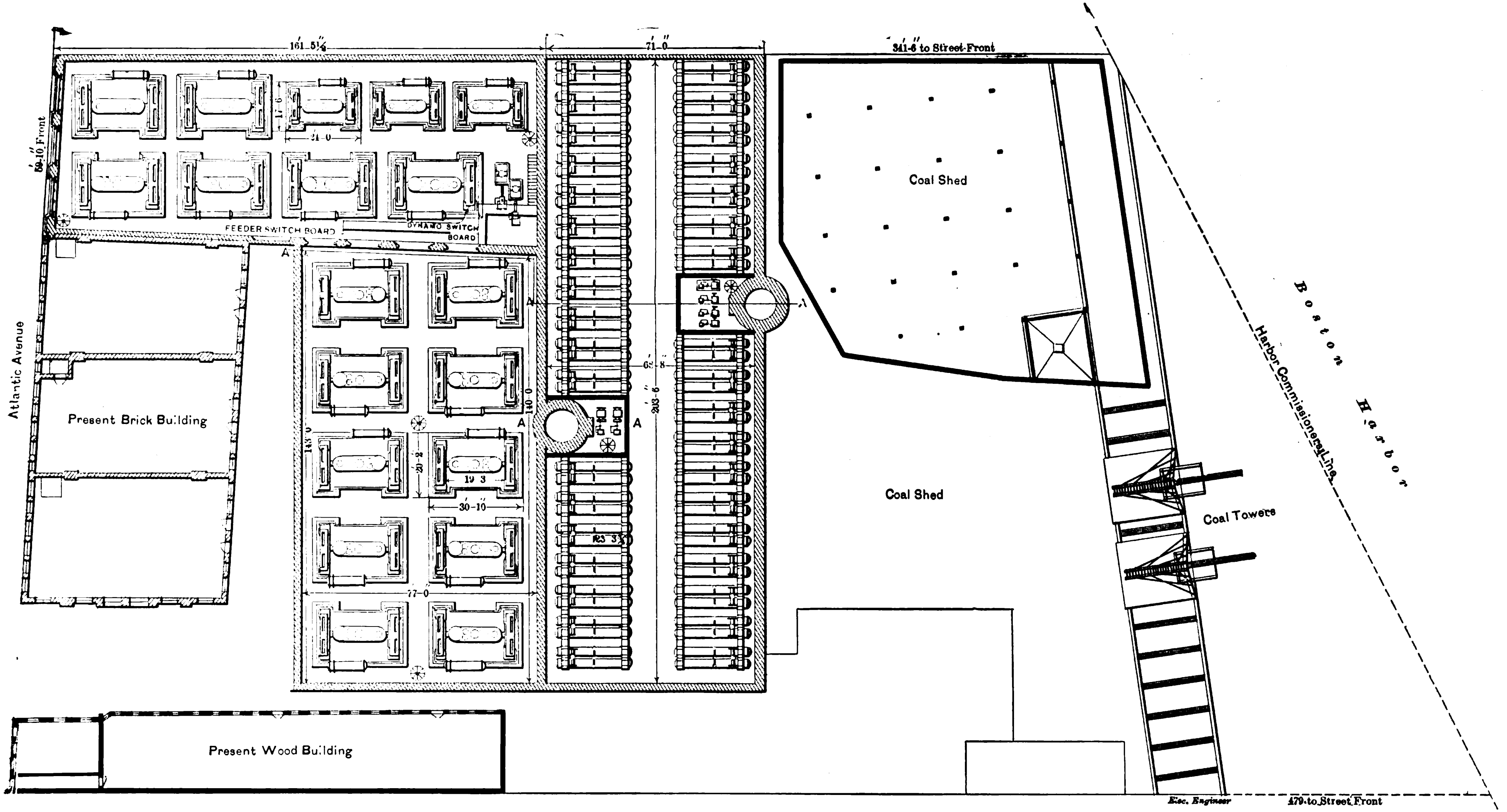
With the above conditions in view a tract of land was secured on Atlantic avenue, the widest street in Boston, where abundant water could be procured for condensing purposes. The property as shown on the engraving on page 122 covers 100,000 square feet, is 240 feet wide on Atlantic avenue, and extends back 341½ feet to the harbor commissioners' line on the North side, and 479 feet on the South side, being 250 feet wide at that point. Eventually the station will occupy the whole of this area but only about one-fifth of this is being built on at present, the dotted line A, A, A, showing the present dimensions of the station, all to the right of this line being for future extension. The present station has a frontage on Atlantic avenue of 60 feet, the engine-room extending back 160 feet, and the boiler-room 70 feet, behind which extends a coal dock about 135 feet. On the end of this are two coal-hoisting derricks, so that coal can be unloaded from the largest coal vessels, the depth of water at that point at high tide being 30 feet. The dock will be covered in with a shed, and will accommodate 5,000 tons of coal. The general plan of the station when the L addition is completed will contain 25,000 h. p., capable of furnishing current equivalent to 600,000–16 c. p. incandescent lamps connected. At present, however, the station is built for 11,250 h. p., consisting of six 1,500 h. p. engines and generators, and three 750 h. p. engines and generators, with fifteen 325 h. p. boilers at 30 pounds of water per horse power per hour. With the increased economy in steam consumption of the triple expansion engines, these boilers will, however, be able to deliver steam for nearly double their rated capacity.



THE EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.

IV.—THE WHARF.

The station being built on the harbor front, and there being ample depth of water for large coal vessels, it was an easy matter to provide a large and commodious wharf for the storage of coal, equipped with apparatus for unloading the vessels. A large wharf, therefore, has been built, immediately in the rear of the boiler-room, an excellent idea of the construction being given in the elevation shown on this page, and a photographic view of which is shown on page 119, which shows the entire back of the building and chimney. It has an area of about 18,000 square feet, and can easily accommodate 5,000 tons of coal, the coal being delivered here not only for the Atlantic avenue station, but for the other two stations in other parts of the city. It is built on piles of first quality oak, driven in rows parallel to the stream and ten feet apart, the piles being placed at 4-foot centres. On top of the piles are



bolted two 7 x 14 inch hard pine girder caps, to which are bolted by 1-inch bolts 12 x 14 inch hard pine riders. To these are secured by $\frac{5}{8}$ inch bolts hard pine stringers 6 x 14 inches, running crosswise on the riders, to which is fastened 4-inch spruce plank, securely held in place by 8-inch steel wire nails. On the front of the wharf is built a trestle of hard pine, 20 feet wide and 40 feet high, with iron rails on top, on which the two coal towers travel. Two of these towers, extending above the rails 70 feet, are provided, each containing two Lidgerwood hoisting engines for operating the coal buckets. The wharf will be covered from the boiler-room wall to within 5 feet from the front, by a coal storage shed 30 feet high, and, as has already been stated, some automatic system of conveyors will be adopted, not only for delivering the coal to the adjacent boiler-room, but for loading wagons by which the coal is transported across the city to the other two stations.

General Plan of the Property

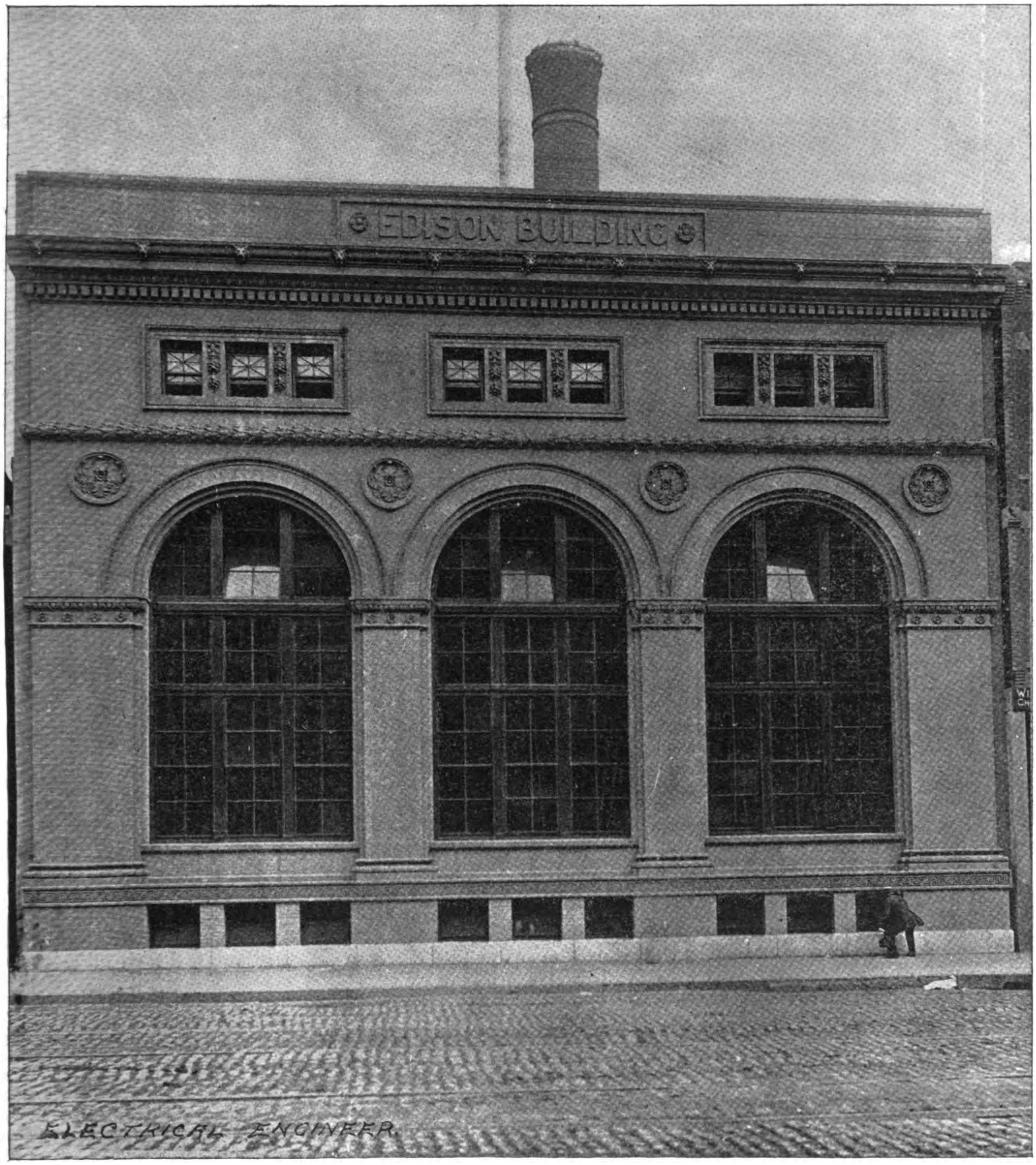
of

The Edison Electric Illuminating Company,

of Boston.

V.—THE FOUNDATIONS.

The station having been built on the water's edge, the solid ground only extending about 88 feet from the front wall, a vast amount of foundation work became necessary. The land had all to be carefully piled first, the piles being driven most thickly under the engine-room floor. Under the engine-room spruce piles, not less than 7 inches at the smaller end, and varying from 25 to 35 feet in length, according to their position, were driven, their centres being four feet apart. Under the walls the piles were placed at two foot centres. Under the boiler-room are eight piers of solid masonry, and each of these rests on 30 piles 35 feet long, being driven to a solid bearing and then cut off at one foot below mean low water. At the back of the boiler-room is a heavy masonry sea wall, resting on seven rows of piles on two-foot centres. The piles in the engine-room were cut off at seven feet above mean low water, and the mud levelled off. On top of the piles is six feet of solid concrete covering the entire engine-room floor, no concrete, however, being used under the walls, the granite foundations of the walls about six feet high resting on top of the piles. The concrete was composed of one part of Portland cement, two parts of sand, and four parts of broken stone.



FAÇADE OF THE NEW BOSTON EDISON STATION.

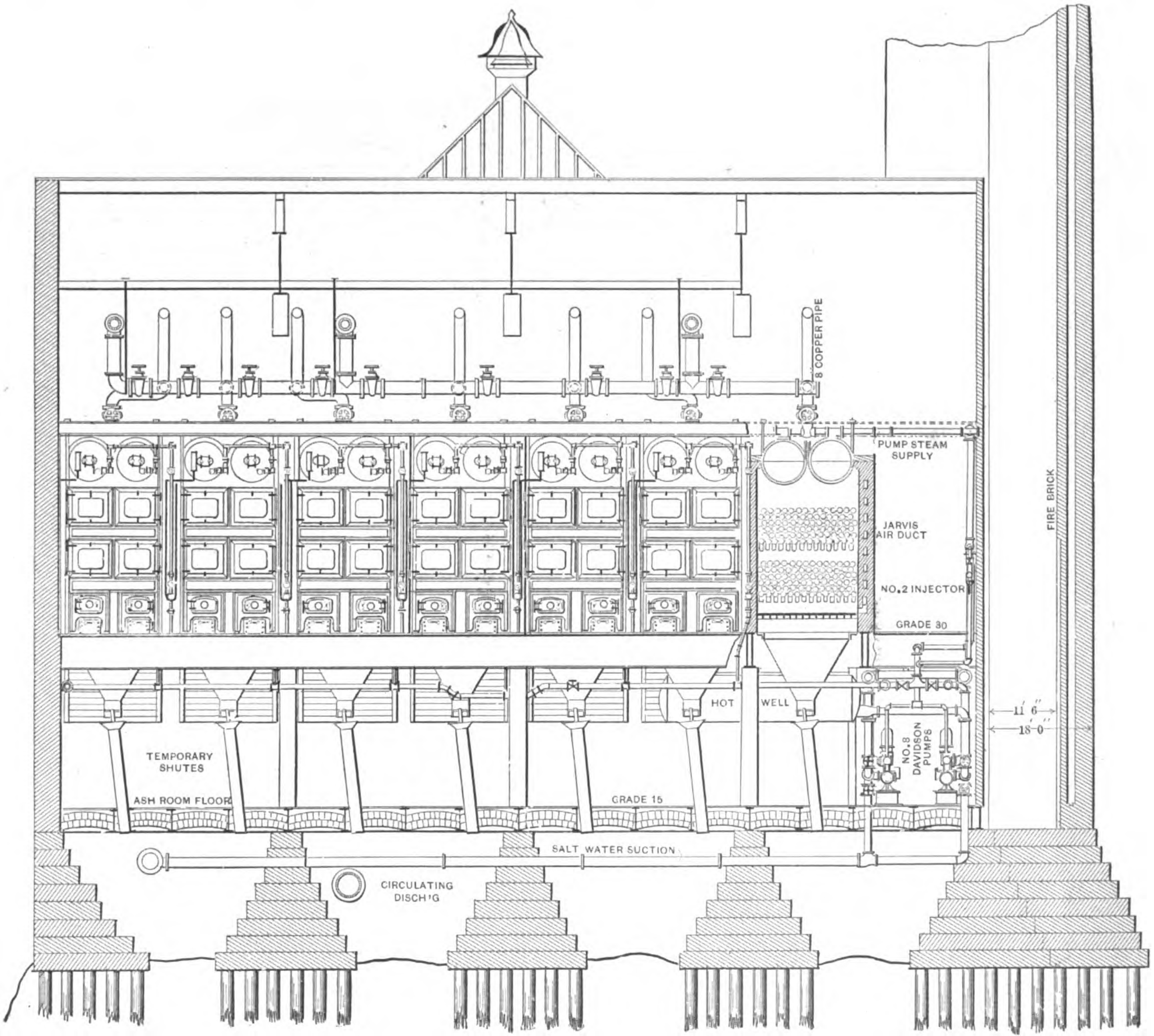
VI.—GENERAL DESCRIPTION OF THE BUILDING.

The entire building above the foundations has been built of brick, and has been erected in a most substantial manner. The front on Atlantic avenue shown on this page is of a very pleasing and graceful design, and is part of the complete plan to occupy the entire 240 feet front. It is built of a special Perth Amboy yellow brick, with terra cotta trimmings, with graceful festoon work round the three large arches, above which appears the name "Edison Building," the whole being surmounted by a substantial flagstaff which carries a flag bearing on it the name of the company. The roof is carried on nine iron girders built by the Smith-Carleton Iron Works, of Boston, 3 feet 9 inches deep and spanning the entire 60 feet. On top of these is a tar-and-gravel roof, the inside finish being of iron lathing with ¾ inch plaster. The building is extra well lighted from the roof, in addition to the windows in the front by four skylight ventilators which occupy about one-third of the entire roof area. In the engine-room and traveling the entire length has been erected a Yale & Towne 12-ton traveling crane operated by hand chains, which runs on rails near the roof supported on brackets from the walls, capable of lifting the heaviest piece of machinery which will be installed and placing it in position. The architects of the building are Winslow & Wetherell of Boston, who also designed the other two stations, the contractors being Whidden & Co., of Boston, who also built the central power station of the West End Street Railway Company, of Boston, which was illustrated in our columns October 21, 1891.

VII.—THE BOILER-ROOM.

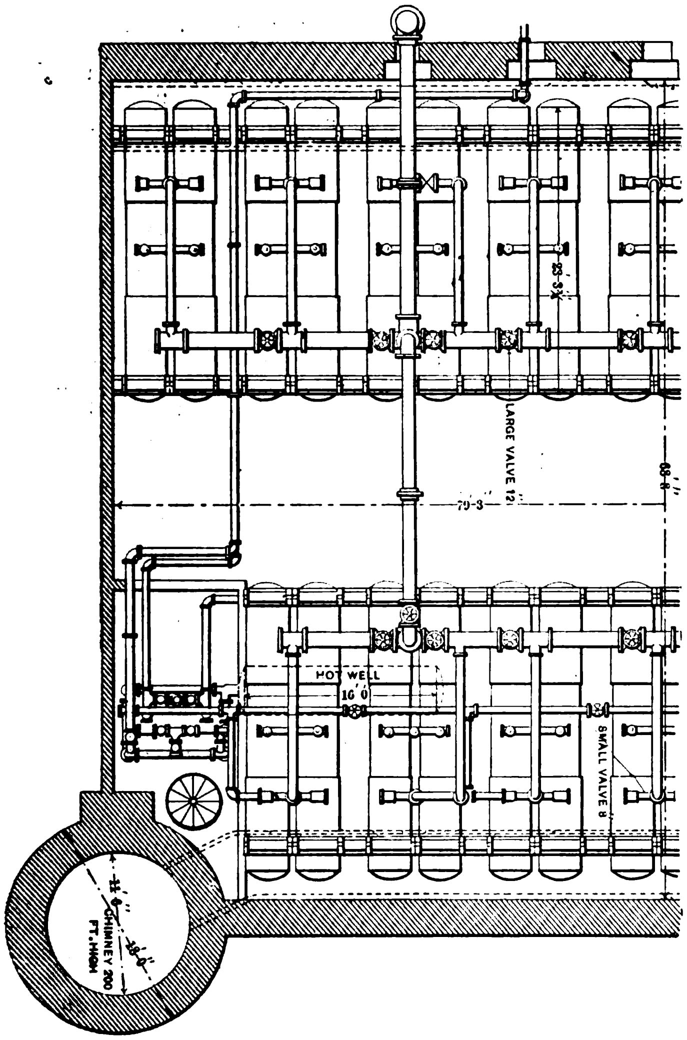
Having thus finished the general description of the property and given an idea of the necessary foundation work, the boiler-room next demands attention. In describing the station the part which is at present erected will alone be alluded to leaving out any detailed description of the proposed increase.

The boiler-room is 68 feet 8 inches deep by 79 feet 3 inches wide and is 33 feet 9 inches high from the boiler-room floor to the roof which has two large skylight ventilators. It has a capacity at present for fifteen 325 h. p. Babcock & Wilcox boilers, seven of these boilers being arranged on the sea-wall side of the room and eight on the engine-room side. The remaining space on the sea-wall side is occupied by the chimney which has sufficient capacity for the fifteen boilers. As will be seen by a look at the side elevation of the property on pages 120 and 121, the boiler-room floor is considerably above the level of the engine-room floor and is 15 feet above the ash-room floor. It is supported on two rows of box columns 18 inches square, there being five columns in each row. These columns support horizontal box girders 18 inches wide by 31 inches deep running the entire length of the boilers and these girders are in turn tied together by plate girders running transversely, 16 inches wide by 36 inches deep. These girders support the whole weight of



TRANSVERSE SECTION THROUGH THE BOILER ROOM.

the boilers, the floor being supported by light tie beams between the girders.



Half Plan of the Boiler Room.

The setting of the boilers is peculiar, owing to their situation on the second floor, each being fitted with Jarvis air ducts to aid combustion. The smoke flue, placed below and in the rear of the boilers, is the same size throughout, being 11 feet high by 5 feet 4 inches wide, and a damper is provided in each downtake, which is regulated by hand; there is also a main damper in each of the two main flues so that each battery of boilers can be shut off at will. The main damper is controlled by a Locke damper regulator situated in the pump-room.

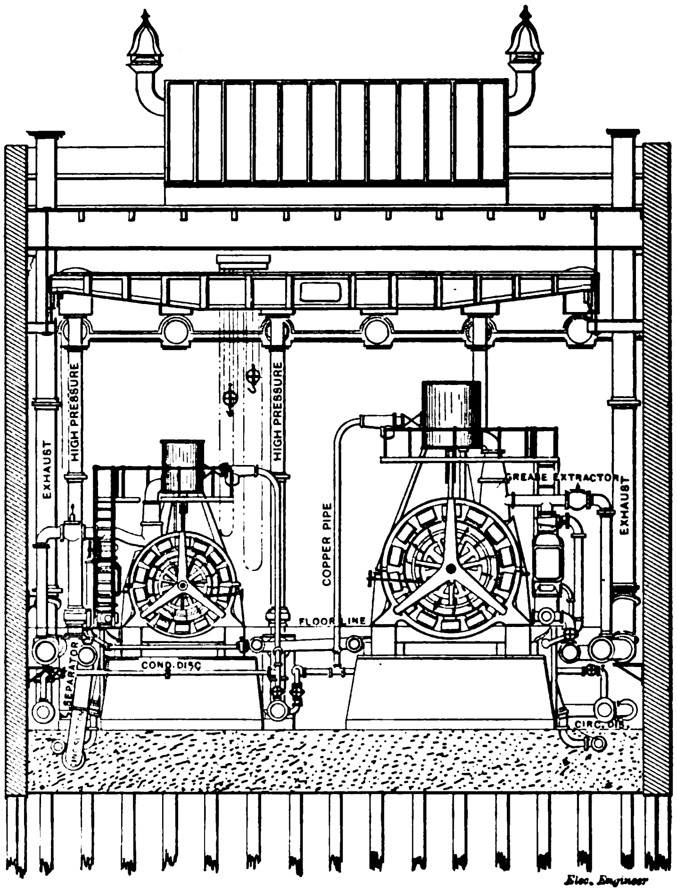
The boilers are 24 feet long, having each two steam drums 42 inches in diameter, connected by a cross-connection from which a copper bend leads to the main steam pipe. The wrought-steel headers for the boilers were imported from the shops of the Babcock & Wilcox Co. in Glasgow, Scotland, there being no means in this country for making them sufficiently strong to withstand the pressure of 225 lbs. at which these boilers can be worked, though at present they will be worked at 160 pounds. Each boiler has 168 tubes 4 inches in diameter by 18 feet long. No steam gauges have been placed on the boilers, but these are all arranged, as shown in the drawing, on the side wall so that the engineer can see at a glance the pressure on each boiler. The usual water gauges and other appurtenances are fitted on the boilers and the pipe connections are all made of polished brass, giving the room a very attractive appearance.

Coal will be run into the boiler-room automatically from the large coal wharf at the rear of the building by some system not yet decided upon. Under each boiler, directly under the grate bars, is an ash chute, shown in detail on page 129, and lined throughout with firebrick, which will hold the ashes as they drop from the firebars, and which can be emptied into trucks on the ash-room floor below by simply pulling a lever which opens a gate on the mouth of the chute. At present, however, this will not require to be done, as there is so much space around the foundation piers of the boiler room, that the ashes will be dumped through temporary chutes into the space below. It is estimated that there is room here for four years' accumulation of ashes, so that the hauling of ashes will not enter into the expense of running for some time to come.

VIII.—THE CHIMNEY.

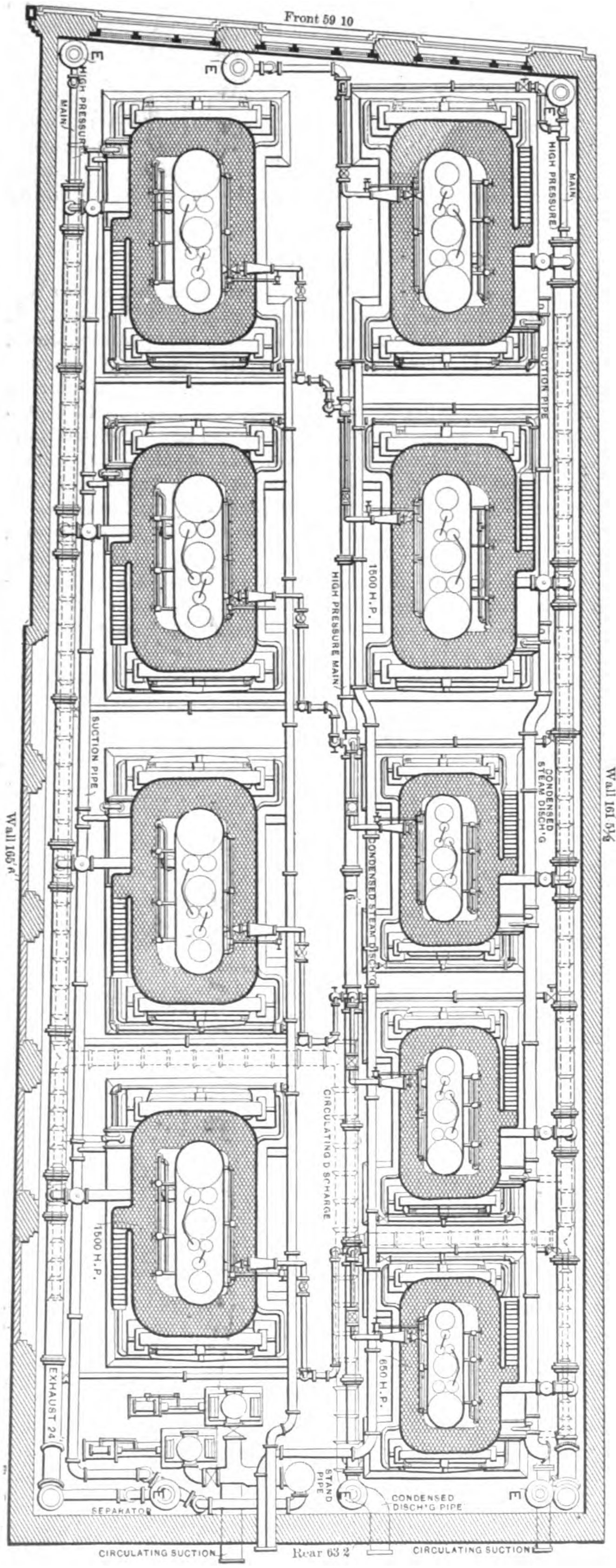
The chimney, which has already been erected, is 200 feet high, and as has been said, has capacity for 15 boilers. It has been built as large as possible under the circumstances, and when the station has increased and necessity demands it another stack will be built. The outside diameter of the stack at the bottom is 18 feet and at the top 14 feet 6 inches, being 17 feet 8 inches in diameter at the widest part of the cap. The outside wall of the stack is 20 inches thick at the bottom, maintaining this thickness to about one-third of its height. At this point it is reduced to 16 inches and about two-thirds of the way up to 12 inches, continuing at this thickness to the top. Corbels are built on the inside 8 inches wide, there being six in the circumference, and these occur the entire height of the core at intervals of 10 feet apart, but do not touch it by a quarter of an inch.

The inside shell or core is 12 inches thick at the bottom, maintaining this thickness for 80 feet, from which point it is reduced on the outside to eight inches and continues this thickness to the top. It is 125 feet high over all and has a firebrick lining on the inside extending 25 feet from



Sectional Elevation of Engine Room.

the bottom. The inside diameter of the core is 11 feet 6 inches, the inside diameter of the top of the chimney being 11 feet 11 inches. The cap is composed of 16 cast iron sections bolted together by flanges, the joints being packed with oakum and covered with red lead and the whole afterwards painted. Two half-inch lightning rods will be placed on the chimney when ready and attached at the bottom to a large plate, immersed in the harbor under the wharf.



Plan of Engine Room.

IX.—THE ENGINE-ROOM AND ENGINES.

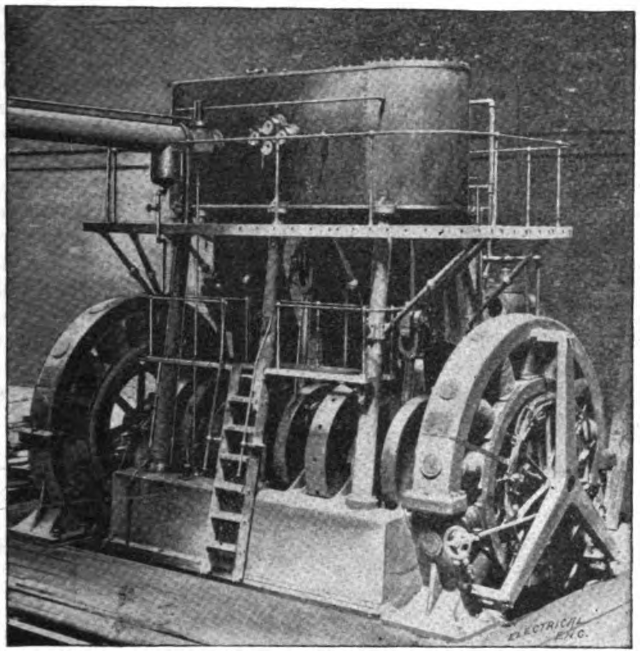
The engine-room is a plain but handsome rectangular building 59 feet 10 inches wide by 156 feet 9 inches long, with a height of 38 feet 3 inches from the floor to the ceiling, the floor being raised 10 feet above the concrete. The walls of the engine-room are of plain red brick, unrelieved by any buttresses, giving a very handsome and solid appearance. At the place where the extension will begin, however, blind arches have been provided for future communication, though it is not expected that these will require to be opened for some years. The engine-room, as finished to-day, will contain nine engines, six being of 1,500 h. p., and three of 750 h. p. The foundations are of brick and rest on top of the concrete floor, being 7 feet high, 14 feet 4 inches wide by 22 feet 6 inches long at the top for the smaller engines, and 19 feet wide by 28 feet long for the larger engines, each foundation having a batter of 9 inches. A plan is shown on this page.

The engines are all of the triple expansion, condensing, vertical type, directly connected to the generators, one at each end, the armatures acting as flywheels. The arrangement is shown on page 127. The dimennsions of the 750 h. p. engine are as follows, none of the 1,500 h. p. size having yet been installed: High pressure cylinder, 16½ inches diameter; intermediate cylinder, 23¾ inches diameter; low pressure cylinder, 38½ inches diameter; all having a stroke of 30 inches. The engines will run with 160 pounds pressure, at 120 revolutions per minute, at which speed they are guaranteed to develop one horse power on not more than 15 pounds of water per hour.

The engine stands 18 feet 3 inches in height from the floor to the top of the cylinders, the foundation box extending three feet below the floor to the top of the brick foundation. They are fitted with piston valves, and have centrifugal governors on the crank-shafts between the crank discs. The cylinders are all steam jacketed, and covered with magnesia, to prevent radiation, the whole being protected with a sheet iron casing. Each engine is provided with a Wheeler surface condenser and a combined air and circulating pump. This condenser and pump sits directly behind the engine on a cast iron drip pan supported by cast iron columns from the concrete floor and heavy cast iron brackets from the foundation box of the engine. All drip from the condensers is caught in this pan and drained off into a proper receptacle. The large engines, which will stand about 25 feet high, will also each have a Wheeler condenser with air pump underneath, the circulating water for these engines being supplied by two compound condensing pumps, each pump being capable of taking care of the entire plant alone. These pumps will be situated in the corner of the engine-room near the door leading into the ash-room.

X.—THE ELECTRIC GENERATORS.

The electric generators, as has already been stated, are coupled direct to the engine, the armatures acting as the flywheels, and making 120 revolutions per minute, at which speed each generator will develop 160 volts and 1,333 amperes, making a total of 2,666 amperes for each engine, or an equivalent of about 5,800 16 c. p. lamps. The two generators on each engine are connected on the three-wire system, one being connected to the positive side of the system, and the other to the negative. They are of the multipolar type having each 14 poles, and were built by the Edison General Electric Company, at their Schenectady factories. The foundation box of the engine serves also for the foundation for the heavy circular castings carrying the fields. The field casting is adjustable vertically so as to allow for the wearing down of the engine shaft bearings, and is entirely insulated from the foundation box. The field spools are all connected in multiple, and, together with

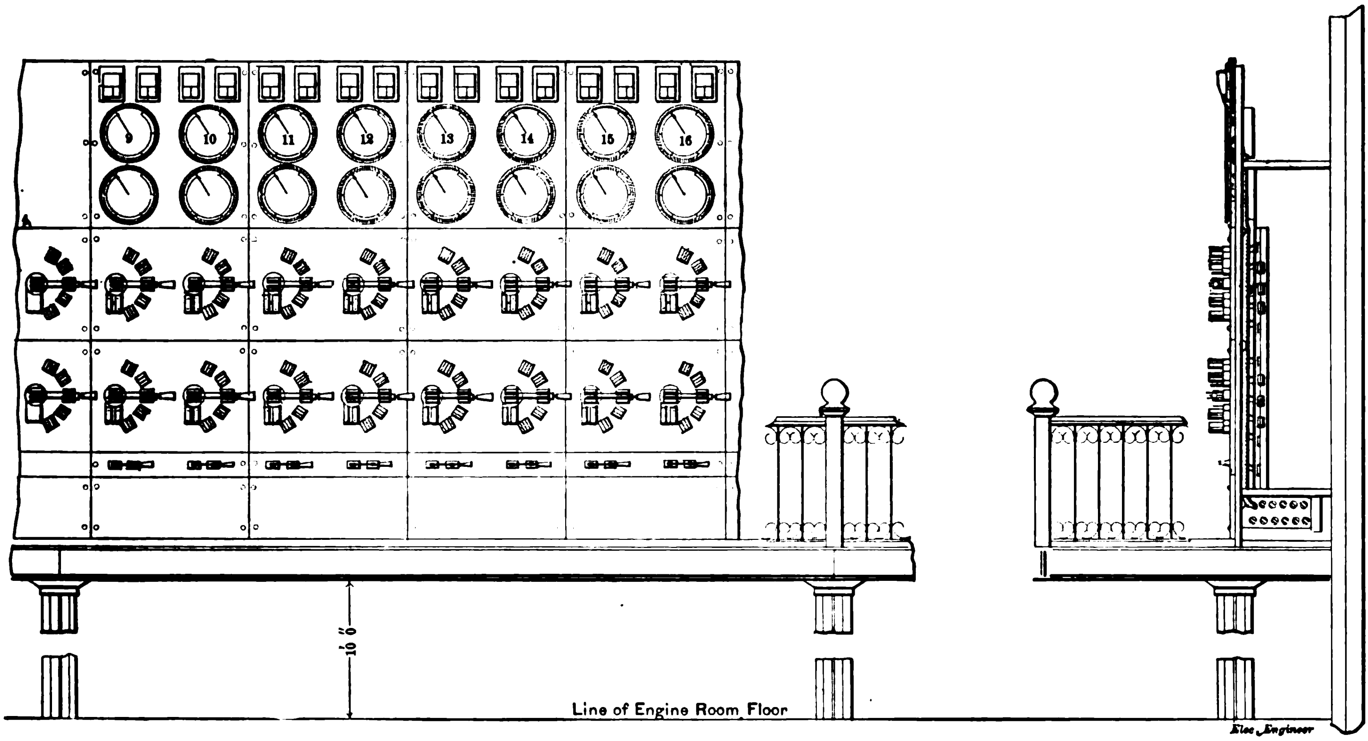


Direct Connected Engines and Generators.

the field casting and all the fittings except the armature, weigh 32,400 pounds. The armature consists of a cast iron pulley, on the outside circumference of which is bolted and keyed a brass rim about 1 inch thick, having spokes which carry the laminated core and the winding. The winding consists of 980 sections, each being composed of a heavy **U**-shaped bar of copper which with one section of the commutator forms one complete turn around the laminated core, the commutator on these dynamos being on the side of the armature. The armature weighs alone 10,900 pounds making the total weight of each generator 43,300 pounds. The fourteen sets of brushes are supported on a circular frame, which revolves on a hub supported by three heavy cast iron arms, radiating from the centre, and attached at the outer ends to the field casting. There are two brushes on each holder composed of fine copper wire gauze, making a light but sure contact. A lever is provided on the front of the dynamo by which all the brushes can be lifted from the commutator simultaneously by an ingenious system of levers. By means of a hand wheel all the brushes can be adjusted simultaneously and in addition each brush can be adjusted individually. The dimensions of the generators are as follows: Diameter over fields, 10 feet $3\frac{3}{4}$ inches; height from floor to top of field, 9 feet $1\frac{7}{8}$ inches; diameter of armature, 7 feet $\frac{5}{16}$ inch; bore of field, 7 feet $\frac{11}{16}$ inch; diameter of shaft, 8 inches; face of commutator, $5\frac{1}{2}$ inches wide and having about the same outside diameter as the armature. Every alternate brush is of opposite polarity, and the brushes of similar polarity are connected together by three strands of copper cable. The brushes of similar polarity are connected by means of heavy flexible cables to terminals one on each side of the frame of the dynamo, into which are soldered the cables which lead to the electrical gallery where are situated the controlling switches.

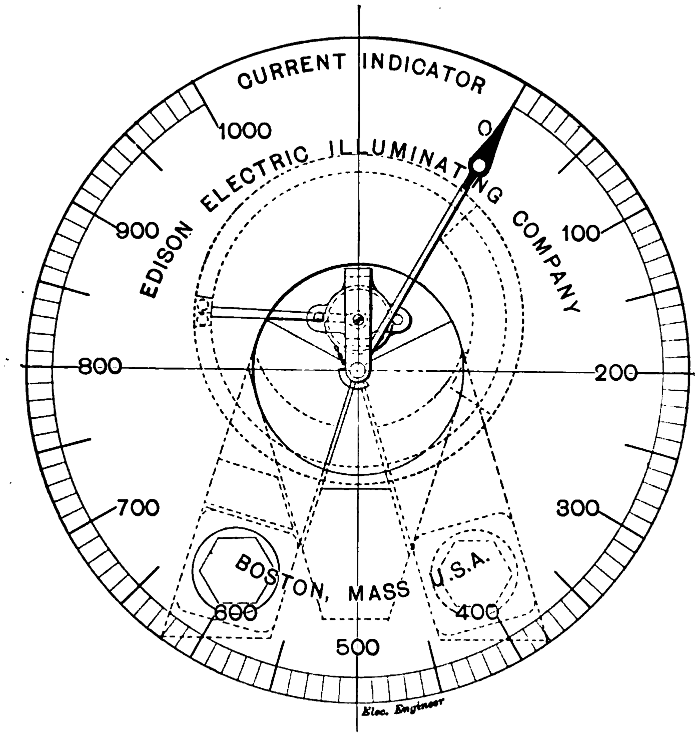
XI.—THE ELECTRICAL GALLERY AND FEEDER SWITCHBOARD.

One of the most important features in any station is the switchboard or series of boards, from which the electrical output is controlled, and in a station as large as the one described it becomes necessary to have a well-designed electrical gallery in which all the controlling devices may be installed, and where they can readily be handled. As will be seen in the general plan of the station on page 122, the electrical gallery has been erected on the side of the wall, at the place where occur the blind arches leading to the proposed extension. Thus, when the extension is built another gallery can be put on the other side of the wall, and so have all the controlling devices together. The

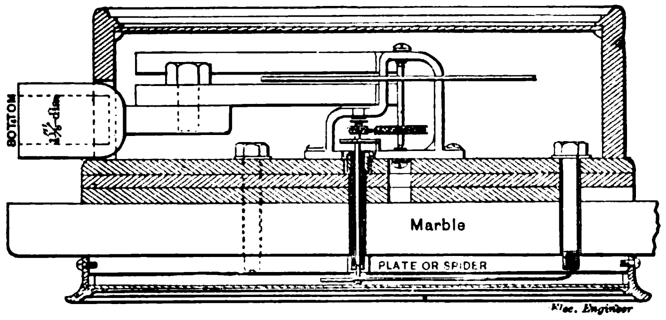


The Feeder Switch Board.

gallery is supported on iron columns from the concrete floor below, and is 10 feet above the engine room floor. It is composed of iron girders, is six feet wide, and has a slate floor two inches thick and four feet wide from the front of the feeder board, leaving a passage way at the back of the board. The length of the gallery is about 40 feet, and from the boiler-room end extends at right angles a short gallery for the dynamo switchboard, the whole being surrounded by a handsome iron railing. In designing the feeder switchboard it was determined at the very outset to have five different bus wires on each side of the system, so that five different pressures could be used. In this way a much better distribution of potential could be made on the feeders of various lengths, a long feeder being connected to a bus wire carrying the highest voltage in the station, while a short feeder would be connected to a bus wire carrying a somewhat lower voltage. By this method the feeder ends would always be maintained at a uniform potential, and the necessity for equalizers on the feeders be entirely eliminated. Two of these bus wires will probably be used to run the circuits of the other two stations, should it ever be deemed wise to shut these down in times of light load or for any other purpose. The feeder switchboard is vertical, and the framework consists of four-inch channel irons bolted to the gallery floor beams at the bottom and the top to horizontal channels fastened to I beams let into the wall. The board itself is made of marble and stands 10 feet high, the height being divided into four sections of marble. The three top ones are a light chocolate-color Knoxville marble on which are mounted the switches, amperemeters and indicators, while the bottom strip resting on the slate is black, so as not to show any discoloration. At the back of the framework are two horizontal channels, one near the bottom and one near the top, both of which form floors upon which to work, and, at the same time, form receptacles for the cables leading to and from the switchboard. The bus bars are at the back of the board supported about 6 inches behind the marble in hard maplewood clamps held together by bolts which also fasten them to the iron rods which serve as supports. When it is deemed necessary to increase the capacity of the bars, it is only necessary to slacken the bolts, cut the clamps and slip in an additional bar. The board is divided vertically into sections 40 inches wide, each section taking care of two complete feeders.

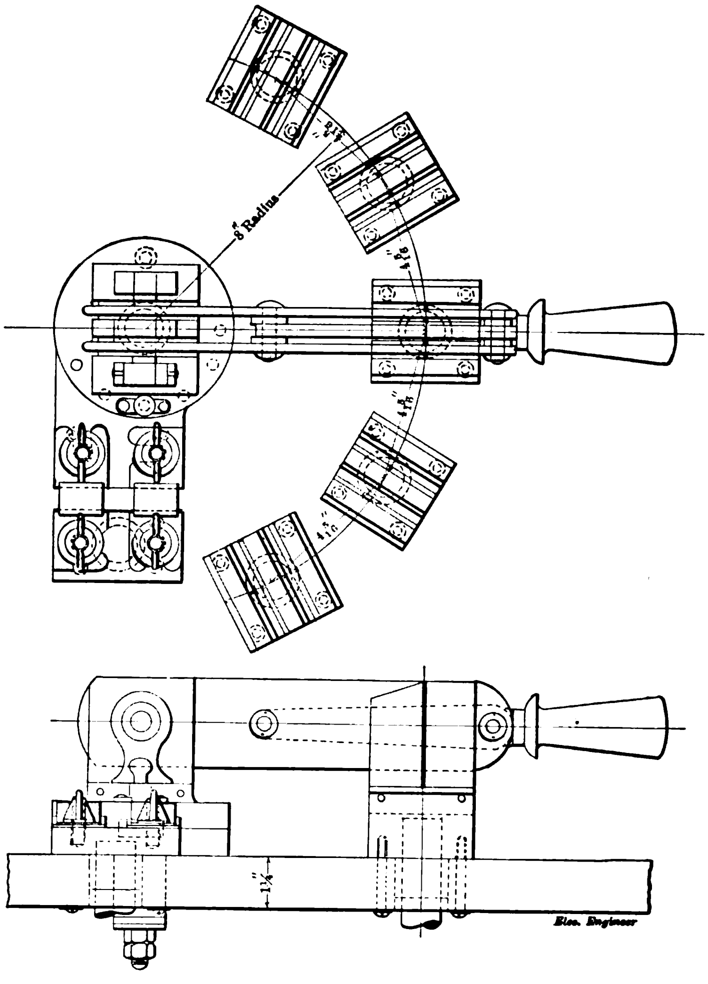


DETAIL OF AMPEREMETER.



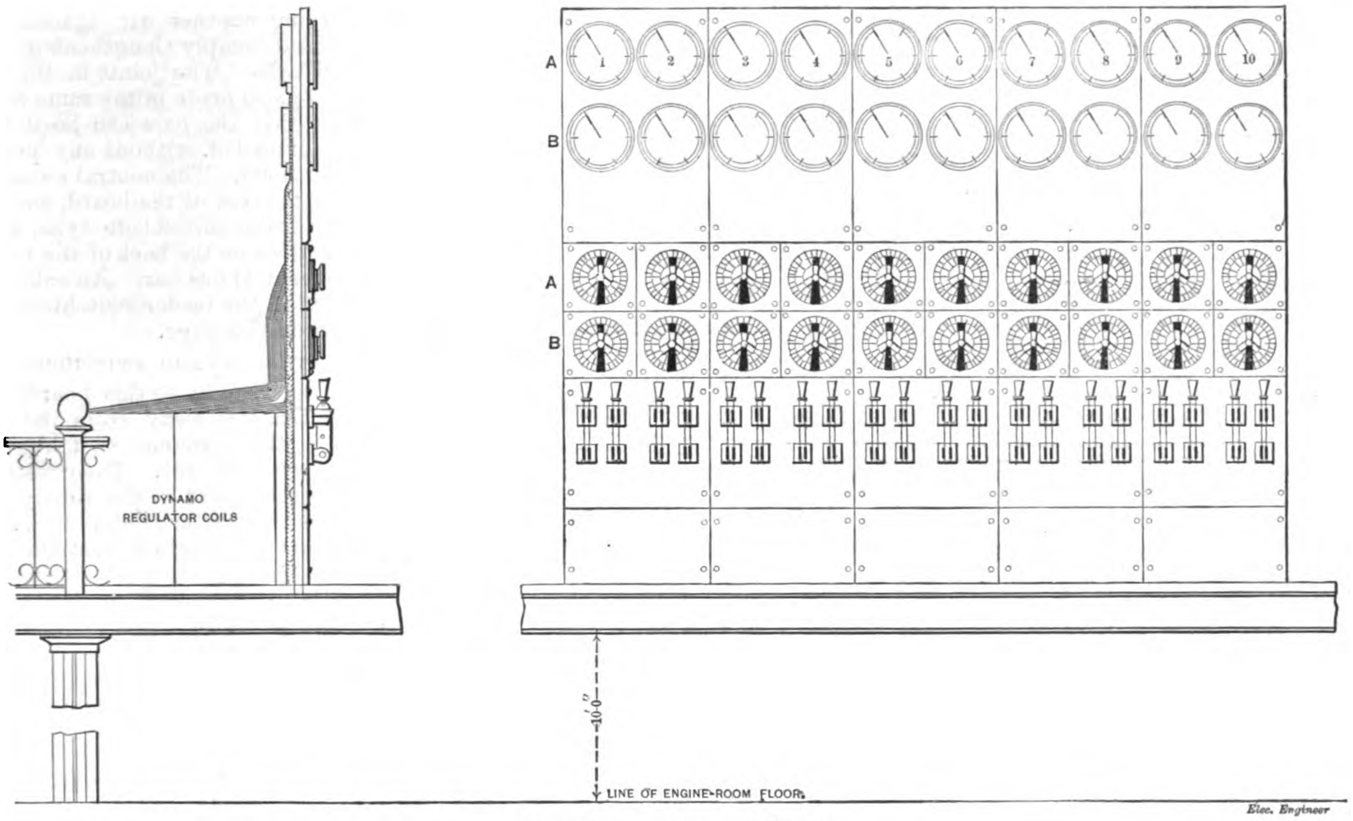
SECTION OF AMPEREMETER.

The engraving on page 127 shows the board with 16 sections, which has been specially designed by the Edison Illuminating Company, and the details of which have been manufactured by A. & J. M. Anderson, of Boston, who make a specialty of this class of work. At the top of each section, are two new type pressure indicators, which are connected to the feeder boxes by pressure wires, and indicate the pressure at the end of each feeder. Immediately below these are placed the positive amperemeters, and below them again are the negative amperemeters. Below these are placed the positive feeder switches, and still lower down the negative feeder witches, the lowest switches connected horizontally being on the neutral feeders. At the bottom is a 16-inch strip



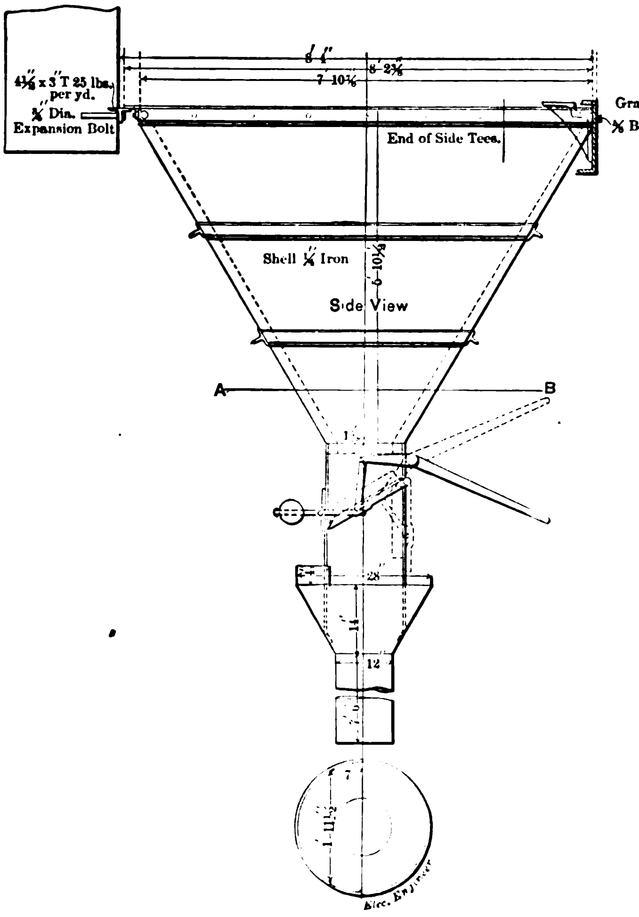
DETAIL OF FIVE-WAY SWITCH.

of black marble on which there is no apparatus, and which only serves as an ornament, being black to prevent any discoloration from oil or dirt. The two sections shown in the engraving without ammeters, carry the dynamo switches, each having five different contacts by which any dynamo can be switched onto any of the five buses. The board, as will be seen, therefore, accommodates at present 16 feeders and four engines or eight generators. The feeder switches, positive and negative, also having five different contacts, throw any feeder onto any of the five bus wires and are each fitted with a double set of fuses; the neutral switches throw the neutral feeder onto the neutral bus.



THE DYNAMO SWITCH BOARD.

The amperemeters shown in detail on page 128 have been specially designed for this board, and are 14 inches in diameter on the face, which is the only part of the ammeter on the front of the board, the working parts being all on the back and cased in. They are constructed on the solenoid principle, and have two flat convolutions through which the current passes, which act on a flat piece of iron suspended on a brass disc. This disc turns on a pivot, which carries a small chain wheel geared to another smaller chain wheel, to multiply the motion of an arbor passing through the marble to the front and carrying the pointer which makes nearly a complete revolution for the full capacity of the ammeter. The face of the ammeter is in a brass case with a glass front. The switch used, an enlarged view of which is shown on page 128 is of an entirely new design, and was invented especially for the purpose of connecting one point with any of the other five points, so that any feeder or dynamo can be connected with any of the five bus bars. This is the first knife-blade switch of large capacity ever made capable of being shifted from one point to another, fastening itself into the contact clips, and making solid contact at the revolving point. There is a spring stop which holds the blade opposite any contact, so that when shut quickly the blade will enter truly and surely into the clip. To each of the five contacts there is a short piece of cable soldered, running through the marble, the other end being soldered to a composition block of the same width as the bus bar, and long enough to give proper contact. This block is clamped to the bus bar by two cast iron plates bolted together, so that connection can be made at any point on the bus, avoiding



DETAIL OF ASH CHUTE.

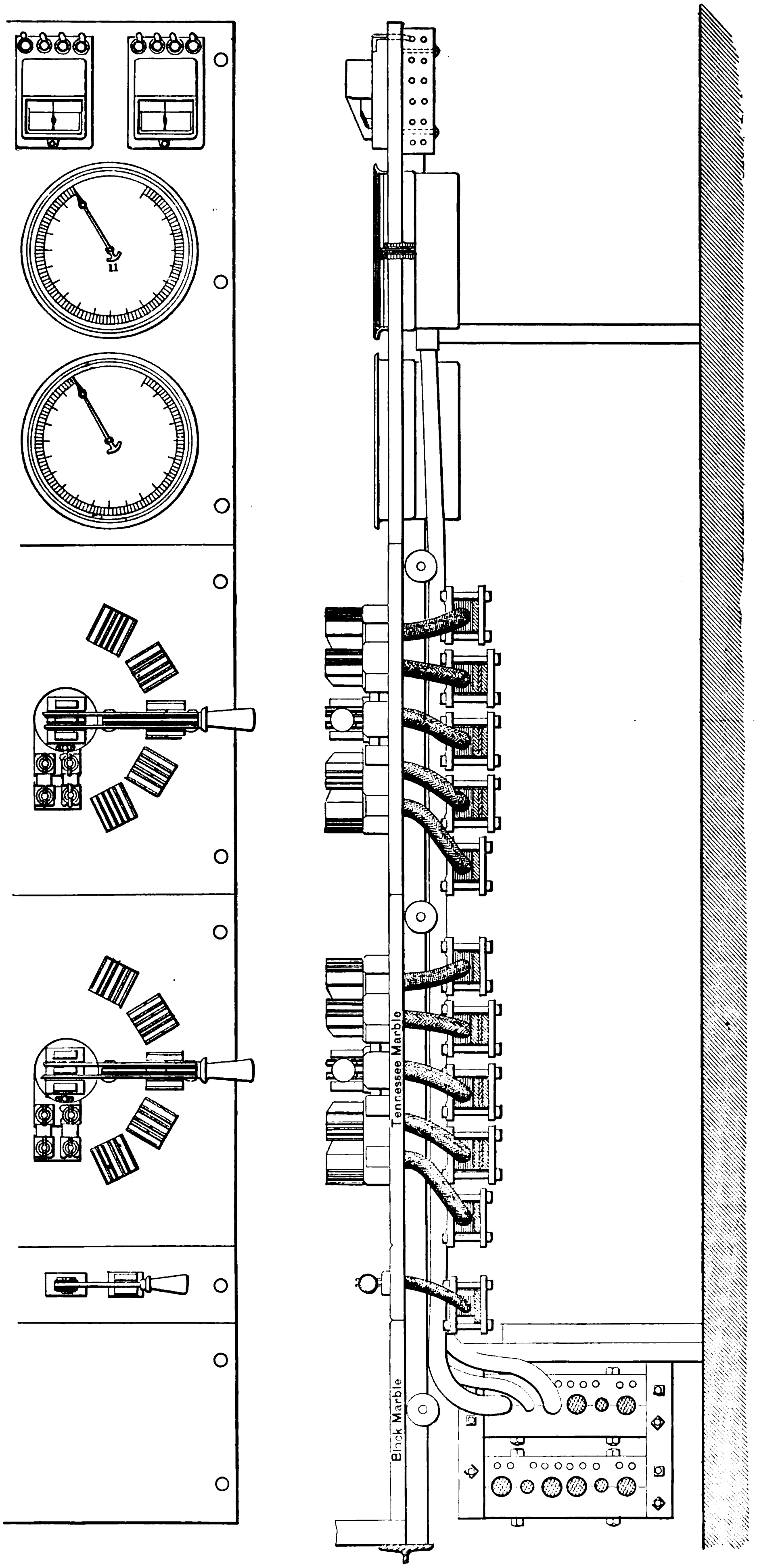
all necessity for holes. This arrangement also allows for any increase in the bus bar, which would be made by laying another bar against the first and simply lengthening the clamp bolts. The joints in the bus bars are also made in the same manner, so that the bars can be indefinitely extended, without any necessity for holes. The neutral switches are on the foot of the board, and are of the plain knife-blade type, with connections on the back of the board to the neutral bus bar. An enlarged section of the feeder switchboard is shown on this page.

XII.—THE DYNAMO SWITCHBOARD.

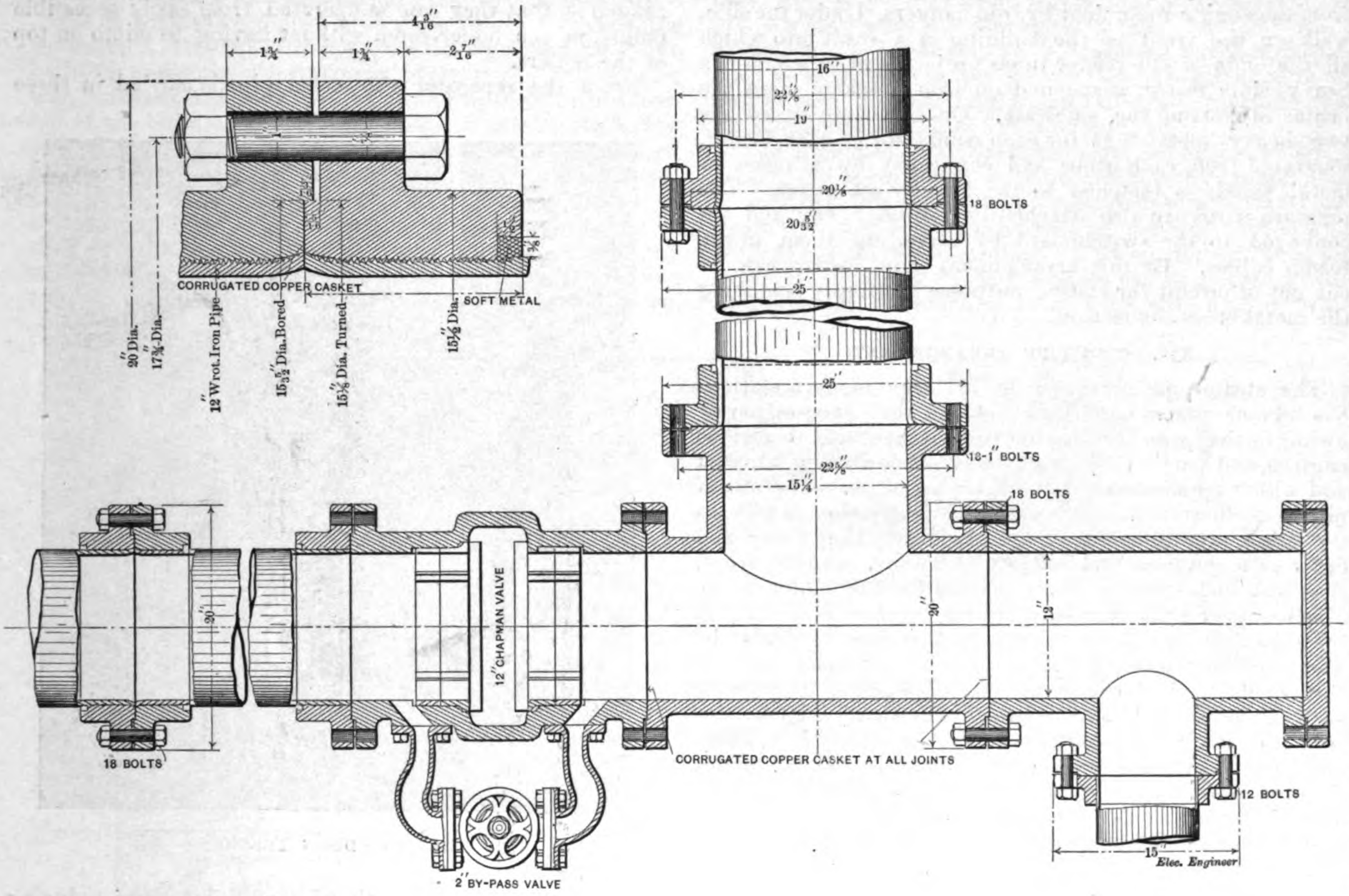
At right angles to this board and about ten feet away from the end of it is the dynamo switchboard, shown on page 129. The construction of this board is practically the same as that of the feeder board, except that the vertical sections are 30 inches wide instead of 40 inches. It is also composed of Knoxville chocolate-colored marble with a black strip at the bottom. At the top of the board are the dynamo amperemeters of the same construction as the feeder amperemeters, though of greater capacity, having been built for 200 kilowatt generators. Immediately below these are the pilot lamps and small switches for galvanometers for comparing the pressure on the dynamos when starting up. Below these are the rheostat hand wheels and contacts for regulating the fields of the dynamos, two to each engine, or one to each generator, the rheostat itself being situated behind the board on the floor of the gallery. Each section of the board accommodates two complete engines or four generators, the drawing showing accommodation for ten engines. Below the regulator hand wheels is a double knife-blade switch, the two blades being on the same handle, which is capable of transmitting about 1,800 amperes. These amperemeters and switches are necessarily on the neutral connections between the two generators, and the bus bar of the dynamo board is connected to the neutral bus on the feeder switchboard by a cable with a neutral ammeter in circuit which shows at all times the balance on both sides of the system.

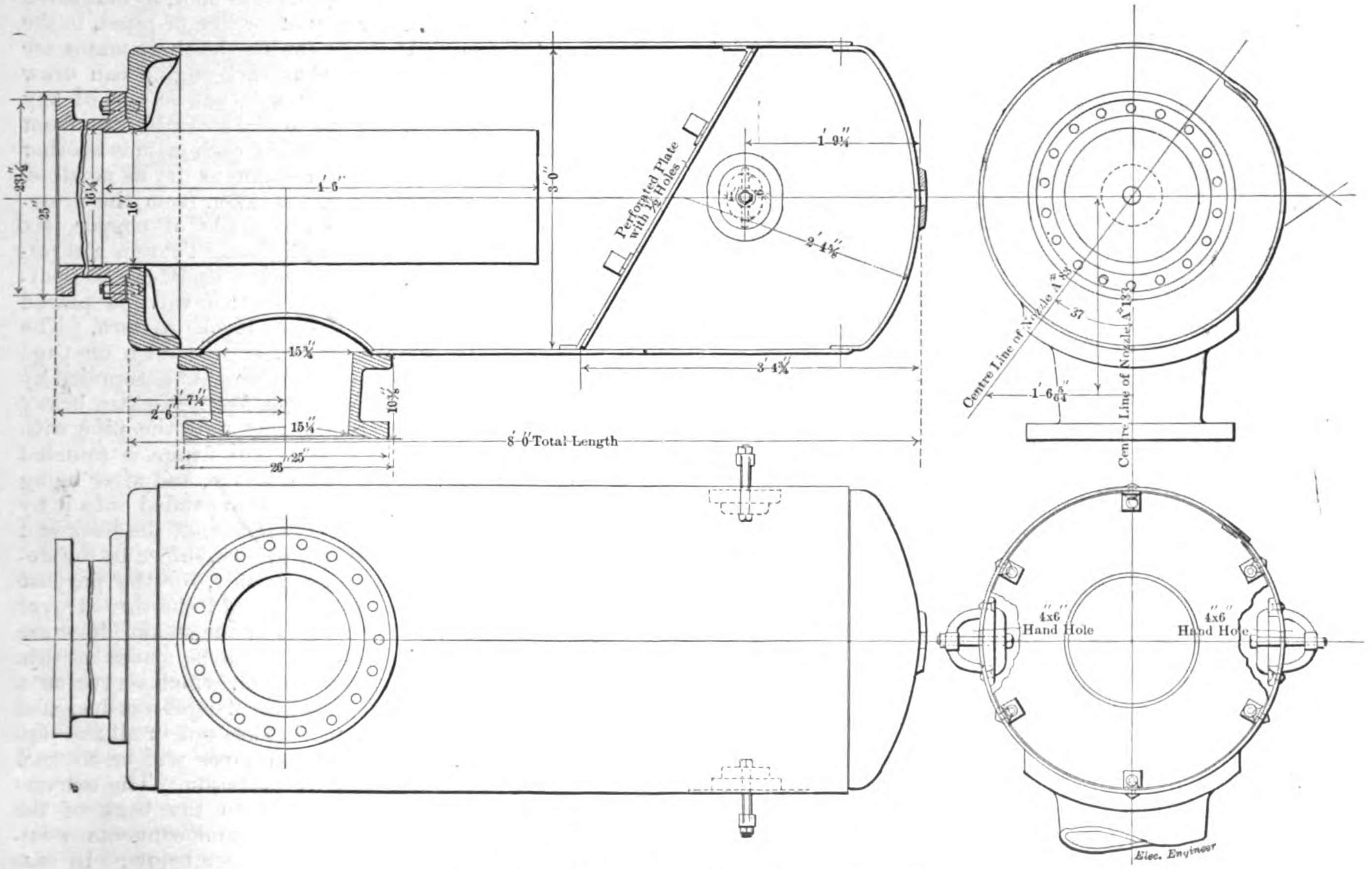
XIII.—INSIDE UNDERGROUND CONNECTIONS.

The cables connecting the generators with the electrical gallery, and the electrical gallery with the underground tubes are all of the Habirshaw manufacture and run underneath the engine-room floor from the gallery through hard maplewood clamps supported on wrought iron wall brackets, the whole being boxed in with slate. They are then supported on maple clamps suspended



DETAIL OF FEEDER SWITCH-BOARD.



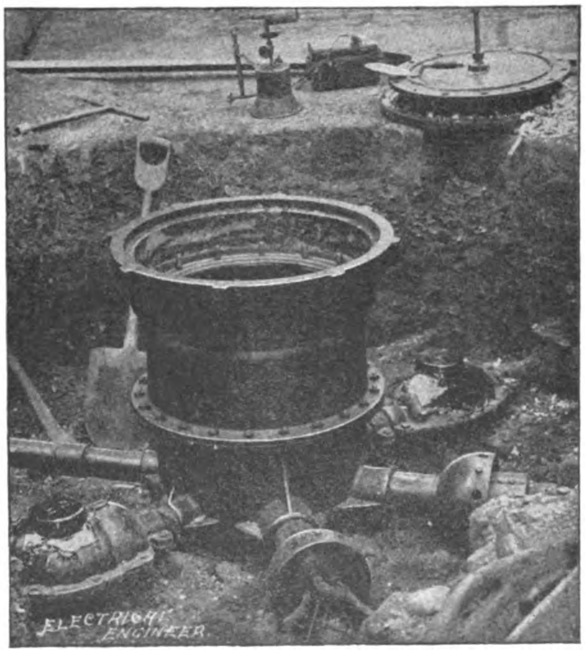


DETAILS OF MAIN STEAM PIPE AND SEPARATOR.

from the engine-room floor by iron hangers. Under the sidewalk on the front of the building is a vault into which all the ends of the feeder tubes project, and in which is a heavy slate board, suspended on iron brackets from the beams supporting the sidewalk. On this slate board are two heavy metal lugs for each conductor of each feeder, separated from each other, and connected by a piece of metal which is fastened to the lugs by set-screws. The pressure wires are also attached in a similar way and are conveyed to the switchboard by stranding them in the feeder cables. By this arrangement any feeder can be cut out of circuit for testing purposes by simply removing the metal cross-connection.

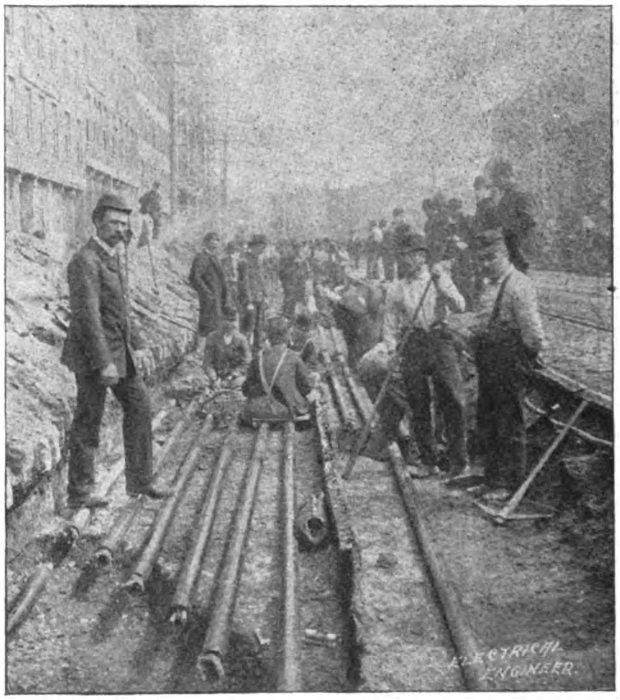
XIV.—THE PIPE ARRANGEMENT.

The steam-pipe arrangement in large modern stations has become a most important factor of their success, partly owing to the large horse power to be transmitted to various engines, and partly to the high pressures now being adopted and which are necessary for triple expansion. The steam piping is, therefore, well worthy of description as well as the other piping necessary for the circulating water and other uses. Across each battery of boilers, near the front, runs a 12-inch steam main, connected to each boiler by an 8-inch copper pipe, having a double bend so as to provide for expansion and contraction. In this line of pipes the valves are so placed that any section of the main, with its corresponding boiler can be cut off without interfering with the action of the remainder of the steam system; this is in addition to the usual stop valve on each boiler. These two lines of pipe are tied together by three 12-inch mains, situated above, near the roof-girders, and are carried, as are also the other pipes in the boiler-room, on iron hangers suspended from I beams which run between the roof girders. From the line of pipe over the battery of boilers nearest to the engine-room and opposite the point where the cross-lines are tied, run three 16-inch mains horizontally through the engine-room wall. Here they turn down on the inside of the engine-room wall into the steam separator, which rests on a brick foundation on the concrete floor below the engine-room floor. On top of each separator is placed a 16-inch Chapman heavy pressure by-pass valve, so arranged that it can be opened or closed from the engine-room or boiler-room. All the valves on the pipes in the boiler-room, which are also Chapman valves, are arranged so that they can be operated from easily accessible points in the boiler-room without having to climb on top of the boilers.



An Edison Feeder Box.

From the separator the steam pipe is carried in three heavy lines the full length of the engine-room, reducing from 16-inch nearest the separators to smaller sizes at the further end. These pipes are supported on iron rollers in iron brackets which rest on the concrete floor, so that there are no main steam pipes, nor any other line of pipes, in the engine-room proper. At each engine the three mains are tied across in such a manner that each engine can draw steam from either of two mains at will, and in case of any one main being disabled, the entire plant can be run from the other two. At the extreme end of each main is another steam separator, so as to keep the steam as dry as possible. The steam pipe for each engine is taken from the cross-pipe connecting two mains, and is made of copper, six inches in diameter for the smaller engines. There is a throttle valve on each engine, so arranged that it can be operated from the floor, and just outside this valve is placed another steam separator of the De Rycke pattern. The main steam pipe, the details of which are shown on page 131, is made of extra heavy wrought iron tube, supplied by the National Tube Works, the flanges being of extra heavy gun iron of special design and screwed onto the pipe with a fine thread cut on a slight taper. The flange is rounded out on the end of the bore at the face, and after being screwed onto the tube the latter is expanded into it by hammering. As an additional precaution, at the back end of the hub of each flange is cast a groove, shown in the detail, larger on the inside than the outside, for the purpose of caulking in a soft metal gasket should the thread ever show signs of leaking. The flanges of the steam pipes are fitted with a "recess" joint, in which is placed a thin corrugated Wainwright copper gasket, which serves as a packing. The whole arrangement of the flanges was designed by Wm. H. Gallison of Boston, who has put in all the piping in the station. All the steam pipes will be covered with magnesia to prevent loss by radiation. The exhaust pipe on each engine is attached to the back of the engine on the low pressure cylinder and connects vertically with the Wheeler surface condenser below. In case of accident to the condensing apparatus, however, there

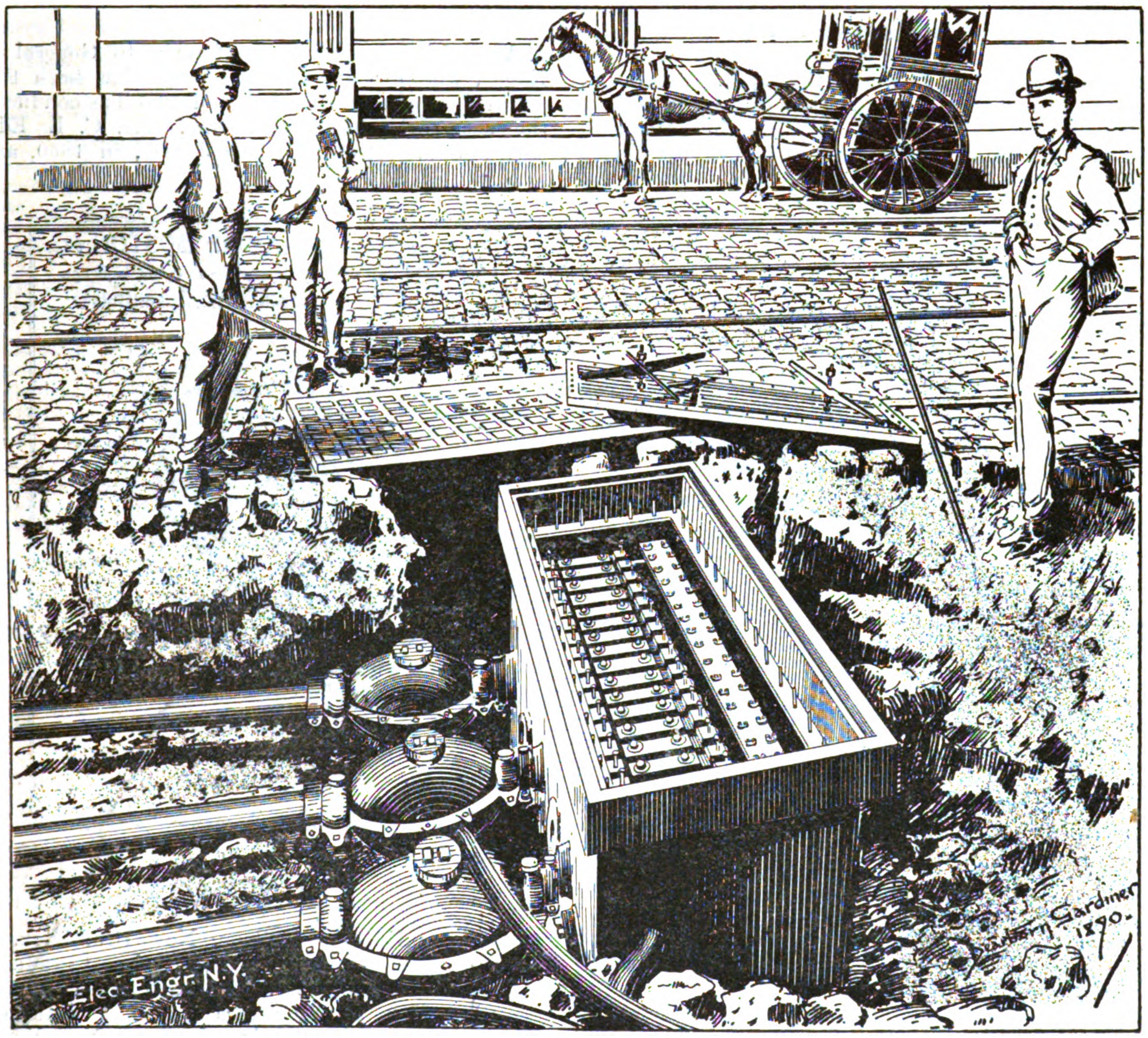

ELECTRICAL ENGINEER.

Laying Edison Tubing.

is also provided a free exhaust into the atmosphere, which connects with the exhaust pipe just before it enters the condenser. This free exhaust runs the whole length of the building under the floor, supported from the wall by cast iron brackets, and then runs vertically upward in one corner of the building to the roof, where it discharges a few feet above. This pipe, having to stand but little pressure, is built of spirally riveted galvanized steel. Close to the engine, on the exhaust pipe, is a De Rycke grease extractor, and between the condenser and the connection to the free exhaust is an automatic relief valve in case of any trouble with the condenser. Ordinarily this valve is closed to the free exhaust, but, should the condenser break down, the steam pressure would automatically open the valve and the engine would exhaust through the free exhaust pipe into the atmosphere, the engine running non-condensing.

From the condenser the condensed steam is discharged through pipes provided for the purpose, 4 inches in diameter, of which there is one for each condenser, connecting with a 12-inch pipe, one on each side of the engine-room floor suspended from the floor beams. These pipes lead to the hot well, situated in the ash-room, and are suspended from the boiler-room girders close to the pump-room. The hot well, which has capacity sufficient for five engines, is a cylindrical tank 4 feet in diameter by 16 feet long, and is made of $\frac{5}{16}$-inch iron, with dished heads $\frac{3}{8}$-inch thick. From the hot well the water flows by gravity to the boiler-feed pumps situated below on the ash-room floor, and is pumped back again into the boilers. Two No. 8 heavy-pressure Davidson pumps, built by M. T. Davidson, of Brooklyn, N. Y., are used for this purpose, and, as auxiliaries to the pumps there are attached in the boiler-room two No. 12 Korting universal injectors, made by L. Schutte & Co., of Philadelphia.

The circulating water is taken from the harbor under the wharf, and is conveyed to the condensers by means of an 18-inch cast-iron pipe, which descends into the water to a depth of 2 feet below the surface at low tide, and is fitted with a foot valve and strainer. The entrance to this pipe is further protected by enclosing its end in a large wooden box, one side of which is fitted with wire netting, which will pass all the water necessary but prevents any hard substance from entering. The suction pipe for the circulating water is suspended from the wharf and runs under the ash-room floor through the wall into the engine-room, where it is suspended from the floor girders. In the ash-room is an 18-inch Chapman valve and a T connection to the boiler feed pumps, so that the boilers can be fed with sea water should any accident occur to the city water pipes at the same time that the condensers might be out of order. At each condenser is an 8-inch connection fitted with a Chapman valve. The discharge from each condenser is by means of a 6-inch cast iron pipe, which connects with a line of vitrified pipe buried in the concrete foundations. There are two lines of these pipes, one for each side of the engine-room, varying from 15 to 18 inches in diameter,

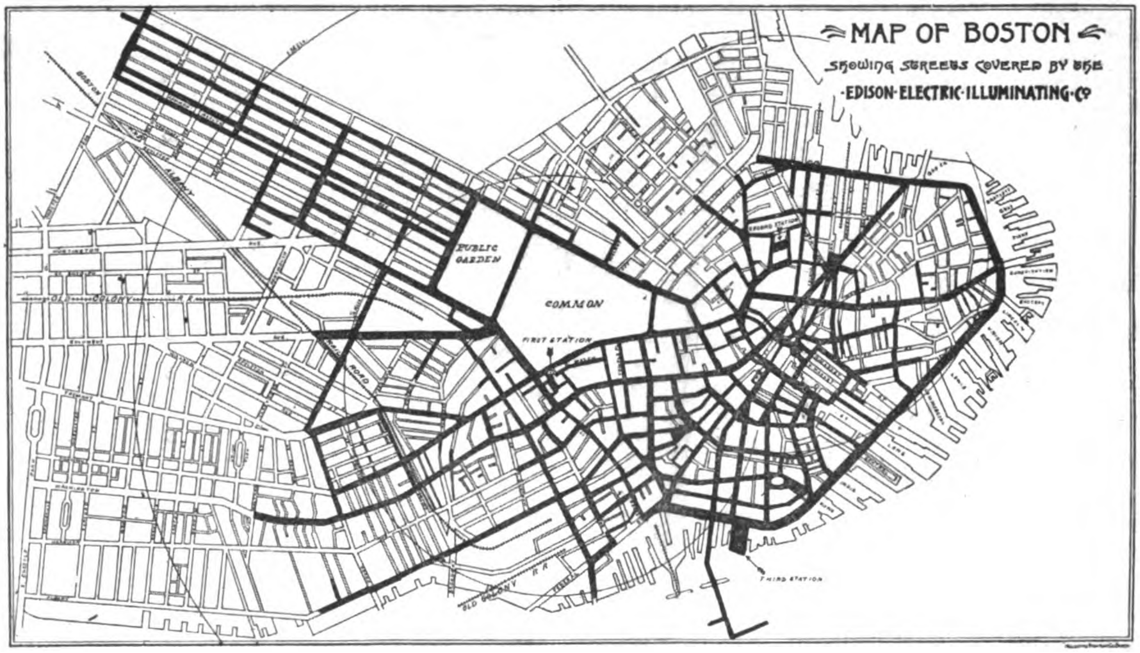

Elec. Engr N.Y.
Gardiner 1890.

A FEEDER TESTING BOX.

and connected to a 24-inch cast-iron pipe, commencing at the ash-room, and running 80 feet out underneath the wharf, where the end turns down and is submerged two feet under water at low tide, thus relieving the pump of a large part of the friction of the water. The discharge pipes are all pitched 6 inches to the hundred feet. All the drips from the high-pressure steam pipes are returned to the boilers by means of the Westinghouse, Church, Kerr & Co.'s patent steam loops, which are attached to each separator, and also at intermediate points in the line whereever the water might collect. All other drips from the engines, pumps, etc., are collected to some central point, where the oil is extracted and re-used, and the water returned to the hot well.

XV.—OUTSIDE CONNECTIONS.

Having thus described in detail the salient features of the new station, and the reasons for building it, it will be interesting to give a few notes regarding the amount of current which the Edison Illuminating Company of Boston is furnishing, and a few details of their outside circuits. There are at present connected to their mains about 65,000 incandescent lamps, or their equivalent in 16 c. p. lamps, about 400 arc lamps, and 3,000 h. p. in motors varying from $\frac{1}{12}$ h. p. to 60 h. p. Connecting all three stations a special 19 conductor cable has been run, which may be used for pressure wires, for telephonic communication, for watch clocks or for any purpose for which it may be required. There are about 50 miles of underground feeders and mains, many of them of the largest size, and these now have a capacity of double the amount of current at present used. All the old style of tubes have been replaced by those of the most recent manufacture, and many new feeder boxes of the latest design, a view of one of which is shown on page 132, have recently been put in. The feeder testing boxes, one of which is shown on page 133, are of their own design, and is used to subdivide long feeders into sections, for convenience in testing, and for locating and overcoming trouble. From the new station have been run about ten miles of underground work, as many as eleven new feeders having been laid in one ditch, as shown on page 132, eight of them being of 1,000,000, and three of 750,000 circular mils. There is still left about 2½ miles of overhead conductor, and this is used chiefly as a power circuit around the wharves. A good idea of the amount of territory covered by the mains of the Edison Company may be had by consulting the diagram of the city of Boston on this page, the deep black lines representing the streets in which these mains exist, and, as will be seen, not only covering nearly every important street in the city but spreading out like the branches of a tree, to the outskirts, from the lower class streets in the North End, and the magnificent avenues and streets of the Back Bay district on which are situated the residences of Boston's wealthiest citizens.



EDISON MAINS IN BOSTON.

XVI.—MR. C. L. EDGAR.

A word in conclusion in reference to General Manager Edgar, who for the past five years, has been the living mainspring of this company, and who has conducted it to the successful position of to-day. Mr. C. L. Edgar was born in Somerset county, New Jersey, in 1860, and graduated from Rutgers' College, New Brunswick, N. J., in 1882, afterwards taking a six months' post-graduate course in electrical engineering. Soon afterward he became connected with the testing department of the Edison Machine Works, then situated in Goerck street, New York, and in the fall of 1883 joined the engineering department, receiving an invaluable training in traveling all over the country for the purpose of inspecting the numerous Edison stations then in existence. About that time, also, Mr. Edgar designed and built a number of small central stations in Pennsylvania, so that when in September, 1887, he came to Boston, as manager of the Edison Electric Illuminating Company of Boston, it would have been difficult to find any one with a wider and more general knowledge of central station work on the Edison system. Since that time, the work of building up the Edison system in Boston has been faithfully carried out by Mr. Edgar, who from the first has shown himself to be a most progressive electrical engineer. That his work has been successful, and eminently calculated to improve the condition of central station design, is amply proven by the magnificent new station which marks his latest achievement.

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. XIV. NEW YORK, AUGUST 10, 1892. No. 228.

No one can do harm but only good, who works with an earnest and truthful spirit.—Faraday.

THE EVOLUTION OF THE CENTRAL STATION.

WHILE the doctrine of evolution in nature may still be the subject of discussion in certain quarters, the operation of its laws in the domain of the arts and sciences is so apparent as to require no special demonstration at this late day. What is termed progress in the arts is, indeed, nothing but evolution—a discarding of parts and processes made useless or cumbersome by changed conditions and, on the other hand, an accretion of new ones, resulting from the same causes and the result of accumulated experiences of utility. If one were to seek for an example of rapid evolution in the engineering world, it is doubtful if a more strikingly characteristic one could be found than that presented by the American central electric station. Called into existence after the apparatus which it was destined to operate had scarcely emerged from the experimental stage, it is not to be wondered at that stations were erected which, after the lapse of ten years, are antiquated and fail to show returns equal to those built on modern lines. But for all that, it does not by any means follow that all these stations suffered from bad engineering alone, though not a few glaring examples of this nature could be pointed out; for much of the improvement in the engineering of modern central stations is due to the progress made in the construction of electrical apparatus which has made possible corresponding improvements in the engineering designs of such stations. In proof of this we need only recall the fact that in the early days high efficiency and output in dynamos were considered to be attainable only with the highest peripheral speeds, machines running at 1,200 to 1,800 revolutions and developing 25 to 50 h. p. being of common occurrence. The first effect of this condition, imposed by the electrician, was to stimulate engine builders to construct high-speed engines, to avoid the employment of countershafting; a stimulus, we may add, which has resulted in developing a type of engine which has been of incalculable benefit not only to electrical engineering but to all kindred branches. But there were those who still adhered to the slow-speed Corliss type of engine, with its countershafting, and many a wordy battle has been fought at the meetings of the National Electric Light Association between the champions of both methods.

It remained for the electrical engineer, however, to silence these disputes by adapting the dynamo to the conditions indicated for obtaining maximum economy in operation; which were soon discerned to involve a dynamo coupled directly to the most economical type of engine for the particular service required. The solution was effected by the introduction of the multipolar machine, the advent of which may be said to have marked an epoch in the history of electrical distribution.

While it has been admitted that some central stations of the early type suffered from the conditions imposed at the time by the electrical engineer, it cannot, on the other hand, be denied that in many cases the most ordinary engineering rules of economic steam power generation were totally ignored and that the electrical engineer has been held responsible for failures brought about by conditions over which he had no control.

The era of the direct-connected engine and dynamo, of which the Edison "Jumbo" combination was the forerunner, is now thoroughly established in Europe, and we are glad to note that American electrical engineers are gradually but surely drifting in the direction of the triple-expansion direct-connected engine. The pioneer work done by Mr. Van Vleck in New York has borne good fruit, and the Boston Edison station designed by Mr. C. L. Edgar, which is described by Mr. A. C. Shaw in this issue, will undoubtedly serve as an excellent example of what a modern electric central station ought to be; and will, it is to be hoped, help to place American central station engineering on a level with the best practice abroad. Mr. Edgar is to be congratulated in having at his back a board of directors far sighted enough to discern the advantages of the improved methods adopted, and it is safe to say that the large new stations contemplated in other cities, such as Chicago, will be similarly equipped with the most modern appliances.

ELECTRIC LIGHTING IN ENGLAND.

ELSEWHERE in this issue Mr. H. Scholey gives a review of the condition of electric lighting in England at the present time, which is deserving of study for more than one reason. It proves above all things the blighting influence of municipal interference on the progress of electric lighting, and from the figures given it is safe to say that but for private enterprise electric lighting in England would still be a dream. Notwithstanding the fact that 78 cities obtained Parliamentary powers to operate their own plants, only two city plants are actually in operation, while on the other hand of the 37 powers obtained by private corporations 22 have resulted in the erection of central stations. Further comment on this state of affairs is unnecessary.

AUTHORITATIVE CREDIT AND DATES FOR PRINCIPAL ELECTRICAL INVENTIONS AND ENGINEERING METHODS.

WE have received the following communication from Mr. Allen R. Foote, special census agent:

IT seems to me desirable that whatever publication may be made by the United States Census Office pertaining to electrical invention and development, shall, whenever practicable, give official recognition to those justly entitled to the honor of having been the first to invent or to bring into practical commercial use the various electrical inventions and engineering methods that are marked features of the present condition of electrical science and art. This is due to those entitled to the credit, as the judgment of their contemporaries. It is due to our successors, who are entitled to correct records made for the present date. It is due to the enterprise and skill of the American people, who need no greater praise than proper historical statements of their achievements in peace or in war.

That it may be demonstrated whether or not this idea can be practically carried out at the present time, I desire to invite, through THE ELECTRICAL ENGINEER, persons having knowledge of the subjects to advise me, giving full name and date, who first invented or used commercially in America continuous current, constant voltage and variable current dynamos, lamps and motors; continuous current, variable voltage and constant current dynamos, lamps and motors; alternating current, constant voltage and variable current dynamos, lamps and motors; and alternating current, variable voltage and constant current dynamos, lamps and motors; also trolley contacts, single or double.

In addition to this information, similar credit and dates for the following engineering methods would be of great present interest and of increasing value, following which should be a description of the first isolated and central station plants and electric railroad.

BY WHOM AND DATE WHEN FIRST COMMERCIAL USE WAS MADE IN THE UNITED STATES OF:

Incandescent Lamps.—Operated by continuous currents; by alternating currents; wired in multiple; in series; to converters; to accumulators; on arc lamp circuits; on power circuits.

Arc Lamps, Single Carbon.—Operated by continuous currents; by alternating currents; wired in multiple; in series; to converters; to accumulators; on incandescent lamp circuits; on power circuits.

Arc Lamps, Double Carbon.—Operated by continuous currents; by alternating currents; connected in multiple; in series; to converters; to accumulators; on incandescent lamp circuits; on power circuits.

Stationary Motors.—Operated by continuous currents; by alternating currents; connected in multiple; in series; to converters; to accumulators; on incandescent lamp circuits; on arc lamp circuits; on power circuits.

Electric Locomotives.—Operated by continuous currents; by alternating currents; connected in multiple; in series; to converters; to accumulators; on incandescent lamp circuits; on arc lamp circuits; wired on power circuits.

Converters.—Used for incandescent lighting; for arc lighting; for stationary power; for locomotive power.

Accumulators.—Used for incandescent lighting; for arc lighting; for stationary power; for locomotive power.

I shall be glad to receive suggestions pertaining to this subject from those who have given it thought or are interested in it.

Society and Club Notes.

THE SOCIETY OF THE U. S. MILITARY TELEGRAPH CORPS AND OLD TIME TELEGRAPHERS' ASSOCIATION.

THE twelth reunion of these two societies will take place at Omaha, Neb., September 14 and 15. The committee of arrangements, of which Mr. E. Rosewater is chairman, has made every effort to make this first reunion west of the Missouri River a pleasant and profitable one. The headquarters of both societies will be at the *Bee* Building, Omaha, and members and intending visitors are requested to notify L. M. Rheem, secretary of the reception committee, Omaha, Neb., of their intention to be present. The festivities will include a trip to Denver, and a complimentary banquet at Millard's Hotel, Omaha.

MR. C. PURCELL TAYLOR, D. Sc., patent expert, of London, England, desires us to announce that although all his tools and instruments were destroyed by fire on July 22, his valuable library is intact, as are also all the most valuable papers, so that his business will not be interfered with.

MR. JAS. UHL, formerly of St. Louis, has been appointed superintendent of the Toledo, Ohio, Electric Street Railway.

Inventors' Record.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JULY 19, 1892.

Alarms and Signals:—

Electric Signal for Mine Shafts, F. W. Bacorn, 479,046. Filed Feb. 27, 1892.

A signaling device for mine elevators and hoists.

Signal for Electric Railways, F. F. Loomis, 479,138. Filed April 8, 1892.

A signal system energized by a portion of the main railway circuit simultaneously operating a number of signals at different points as the car passes some given point.

Switch and Signal Apparatus, J. C. Schreuder, 479,225. Filed Jan. 20, 1892.

An automatic electric switch signal for railways.

Electric Alarm, R. L. Keith 479,282. Filed May 26, 1892.

An electric alarm for shelves, cabinets etc.

Individual Alarm Signal Apparatus, P. Seiler, 479,308. Filed Aug. 1, 1891.

Employs a polarized relay, the armature of which is adapted to stand in three different positions, in connection with a disc moved by clockwork and governed by a magnet.

Electric Railway Signal, T. A. B. Putnam, 479,333. Filed April 15, 1889.

A railway signal in which a partial circuit is carried on the locomotive and co-operates with other partial circuits arranged along the track.

Alarm Lock, F. Mahannah, 479,394. Filed Sept. 29, 1891.

Conductors, Conduits and Insulators:—

Insulator, C. E. Conover, 479,134. Filed Jan. 20, 1892.

An insulator having a diagonal slot opening into the line wire groove.

Clamp for Electric Conductors, J. Ingmanson and R. Lorang. 479,216. Filed July 13, 1891.

Employs a pair of jaws, a tongue laterally projecting from one of them and having a cam-face for engaging the other, and means of locking the jaws against lateral movement.

Connector for Electric Circuits, J. F. Wollensak, 479,322. Filed April 26, 1892.

Employs an insulating piece secured to a face-plate and provided with two sockets for portable electric lights, etc.

Connector for Electric Circuits, W. E. Gill, 479,325. Filed April 26, 1892.

Similar in its object to 479,322.

Cast Joint for Armored Conductors, F. M. Bennett, 479,386. Filed March 28, 1890.

Claim 5 follows:

A combination with two or more metal armored conductors of a hollow cast metal joint and of a hollow core, both provided with perforations and stopping devices.

Dynamos and Motors:—

Armature for Electric Machines, E. A. Sperry, 479,030. Filed Dec. 17, 1891.

Employs a core of thin rings or discs and axially extending projections secured to the end discs or rings through which the tie bolts pass and from which they are insulated.

Dynamo Electric Machine, R. Eickemeyer, 479,118. Filed Dec. 21, 1889.

Employs a drum armature having an iron core and field coils surrounding it longitudinally, and an iron shell surrounding the field and armature in a continuous plane at right angles to the axis of the armature.

Electromagnetic Machine, A. E. Kennelly and J. F. Ott, 479,169. Filed Oct. 21, 1891.

Claim 1 follows:

The combination in a magnet, of a main body, a separate pole-piece, and a strap securing said body and pole-piece together.

Compound-Wound Alternating Current Dynamo, H. Lemp, 479,170. Filed Oct. 17, 1889.

Employs two armatures or armature coils in series with one another, one being the source of current for the work circuit, and a connection leading across from one side to the other of the series circuit and containing an artificial resistance.

Armature for Dynamo Electric Machines, M. J. Wightman, 479,179. Filed Oct. 28, 1891.

Employs flexible lead wires attached directly to the armature winding, each clamped at the point of connection by the wire of the succeeding section.

Alternating Current Motor, T. H. Hicks, 479,187. Filed Mar. 9, 1891.

Employs field magnets, wound with two distinct conductors, one traversed by impulses of one direction and the other by those of opposite direction, and a commutator to separate these impulses.

Lamps and Appurtenances:—

Electric Arc Lamp, M.S. Logan, 479,207. Filed Aug. 29, 1891.

Employs a coil permanently located in the arc circuit, and a feed regulating coil in a branch circuit, an auxiliary coil in a second branch circuit, and means for switching the auxiliary coil in the arc circuit in multiple with the coil permanently located therein.

Hanger for Electric Arc Lamp, C. A. Pfluger, 479,017. Filed Jan. 23, 1891.

Incandescent Electric Lamp, M. A. Richter and J. G. Nolen, 479,090. Filed Feb. 10, 1892.

Claim 8 follows:

A combination incandescent lamp and shade, comprising a shade provided with pendant stem and bulb, having its neck drawn to form a suitable concavity in which the stem of the shade is secured.

Electric Arc Lamp, W. E. Irish, 479,121. Filed Jan. 2, 1892.

Employs a thermo-expansive strip to automatically operate the clutch.

Electric Arc Lamp, E. A. Sperry, 479,029. Filed Apr. 18, 1890.

Employs two pairs of carbons with feeding clamps for the two upper carbon rods and a suspending clamp for one of said carbon rods, which is also provided with a groove encircled by the clamp, so that one carbon will be fed at a time.

Reflector for Arc Lamps, R. S. Dobbie, 479,183. Filed Apr. 8, 1891.

Employs a hollow refractory body, within which the arc is formed, having a refractory block, adapted to become incandescent, supported within it.

Shade for Incandescent Electric Lamps, W. J. Edmond and T. J. Keon, 479,207. Filed Feb. 29, 1892.

Incandescent Lamp Socket, I. Goldkind, 479,359. Filed Dec. 15, 1891.

Employs a rachet wheel, pawl, lever and clutch device in the socket of the lamp for turning the current off or on.

Incandescent Electric Lamp, H. Green, 479,360. Filed Sept. 2, 1891.

Employs a seal connected with the neck of the bulb and comprising depending legs in which platinum leading-in tubes are incased, the filament having its ends secured to the lower ends of the tubes.

Measurement:—

Electrical Meter, A. E. Kennelly, 479,157. Filed Oct. 17, 1891.

Consists of a motor whose armature has one or more coils forming a closed circuit, and second winding forming the ordinary armature coil.

Electrical Meter for Three-Wire System, A. E. Kennelly, 479,168. Filed Oct. 21, 1891.

Employs a coil to which the positive main is connected, and another connected with the negative main, both coils operating on the same indicator.

Electric Meter, J. F. Ott and A. E. Kennelly, 479,171. Filed Sept. 7, 1891.

A meter in which recording counters are moved forward by a motor mechanism, the extent of whose movement depends upon the strength of the current.

Electric Current Meter, J. F. Ott and A. E. Kennelly, 479,172. Filed Nov. 30, 1891.

Similar to 479,171.

Miscellaneous :—

Safety Device for Electric Circuits, M. Thum, 479,035. Filed June 5, 1891.

Consists of a safety device comprising a second or guard conductor adapted to complete the circuit upon an undue displacement of the main conductor.

Electric Wire Support, W. B. Bragdon, 479,052. Filed Mar. 4, 1892.

Rheostat, J. Waring, 479,101. Filed Apr. 28, 1892.

Consists of an insulating slab having binding screws, switches, coils and contacts, with bridges movably supported adjacent to the contacts and held therefrom by a counterbalance.

Thimble for Light-Fixtures, J. J. Miller, 479,139 Filed Apr. 6, 1892.

Electric Belt, D. P. Andrus, 479,147. Filed Dec. 14, 1891.

Electric Brush, R. E. Williams, 479,321. Filed Jan. 2, 1892.

Electric Stop-Motion for Textile Machinery, S. L. Foster, 479,358. Filed July 29, 1891.

Railways and Appliances :—

Conduit Trolley for Street Cars, A. H. Hieatzman, 479,327. Filed Mar. 24, 1891.

Employs a conductor support consisting of a stem and two downwardly inclined plates forming an inverted V, the stem being secured to or formed on the apex of this iron and the plates being provided with openings to receive the securing screws.

Telegraphs:—

Telegraph Repeater, R H, Weiny, 479,178. Filed Feb. 8, 1892.

Employs an independent auxiliary differential magnet, one winding of which is included in a circuit controlled by the armature of the opposite receiving magnet.

Fac-Simile Telegraph, T. A. Edison, 479,184. Filed Dec. 6, 1881.

Claim 1 follows:

A fac simile telegraph having transmitting and receiving instruments, the transmitting circuit being controlled by the depressions produced by marking autographically upon paper or other material.

Telephones and Apparatus :—

Speaking Attachment for Telephones, D. Eldredge, 479,062. Filed Feb. 26, 1892.

Telephone Switchboard, W. Oesterreich, 479,107. Filed Aug. 7, 1889.

The invention consists in the connection between the switches of the different boards and the telephone lines, and with the annunciator drops and the switchman's call and test apparatus, and also in the construction of the jack switches, etc.

Telephone, G. F. Shaver, 479,226. Filed Mar. 2, 1892.

Employs one or more magnets, each forming an incomplete ring and having pole-pieces extending into the ring, the magnets being reversed and laid one upon the other, and a diaphragm adjacent to the pole-pieces.

Telephony, G. F. Shaver, 479,227. Filed Apr. 8, 1892.

A duplex system of telephony over one wire by means of mechanical and electrical vibrations.

Letters to the Editor.

PROF. THOMAS' INCANDESCENT LAMP TESTS.

In The Electrical Engineer for July 27, page 85, Mr. E. G. Willyoung quotes a part of a statement by Mr. J. W. Packard in his articles in your preceding issue, page 57, and also my statement from your issue of July 13, page 39; you add an explanatory note, in which you quote from a letter by Mr. Packard, as follows:

"I had Prof. Thomas' letter as authority for the statement made in this paragraph, but judging from his later publication, there is apparently some mistake about it. * * *" This leaves me under the imputation of saying one thing in correspondence, and exactly the opposite in print. To relieve me of this imputation, I quote from the letter referred to, which was written June 25, in answer to Mr. Packard's request for information as to the performance of the "Packard" lamp in the test as follows:

"I send you to-day copy of paper on lamp test. The Packard lamp is designated by the letter ("—") in the tables and curves. It stood ("——") in the order of blackening, (least blackened being first, etc.;) with a grade of ("—"), the worst blackened lot being graded 100."

The last sentence is the one referred to as authority by Mr. Packard, but it could only be authority for his statement if the word "first" had been written for the dash ("——"). But the word written in place of the dash ("——") as quoted was neither "first" nor "second," but a higher ordinal. My letter and published statement are therefore perfectly consistent.

In making this explanation, I do not wish in any way to criticise Mr. Packard, who has explained that he wrote under a misunderstanding of the sentence quoted.

Benj. F. Thomas.

Ohio State University; Columbus, Ohio.

Mr. Clarence E. Stump, vice-president and manager of the *Street Railway Journal*, was in Chicago last week and was accorded a happy welcome by his many friends.

OPENING CEREMONY OF THE NEW ELECTRIC LIGHT STATION AT PAWTUCKET, R. I.

About fifty gentlemen responded to the recent invitation of Manager S. G. Stiness, to attend the ceremony at the opening of the magnificent new station of the Pawtucket Gas and Electric Company, at Pawtucket, R. I. The new station is situated on the Pawtucket River, about half a mile from the centre of the city, where it has abundant water for condensing. The station has been finished in the most tasteful way, and is surrounded by neatly laid out grounds. In the boiler-room are six Bigelow boilers furnishing steam at present to one 600 h. p. Harris Corliss engine.

From the engine-room an unobstructed view may also be had of the countershafting, which is situated in the basement underneath the dynamo-room floor. The dynamo-room is one large room without pillars, or any other obstruction, and is perfectly lighted and ventilated. An overhead traveling crane of six tons lifting capacity has been installed, and which runs the whole length of the building. On the water front there is ample room for wharfage and about 10 or 12 feet of water, so that coal vessels can easily unload coal almost at the boiler-room door.

After inspecting the station, a light lunch was served, after which the visitors were invited to partake of a "clam dinner" at Bullock Point, on the Providence River. Accordingly, all boarded one of the small steamers plying between Pawtucket and the home of the clams, and had a most enjoyable sail down the Pawtucket and Providence Rivers, the weather being perfect. Gathering all together on the upper deck, the hour's sail was pleasantly passed, Messrs. William Anderson, of the East Boston Gas Company, and C. M. Coburn, of the Liberty Oil Company, of Chelsea, serving as most efficient "end men," whiling away the time pleasantly with many a darkey song. When the almost insatiable appetites of the clam-eaters had been satisfied the party broke up into small groups and gave themselves up to the enjoyment of the hour.

A return was made in the cool of the evening, and after three rousing cheers for Mr. Stiness for his most enjoyable hospitality, the party broke up, and a happy and profitable day was at an end.

THE WILDER ELECTRIC HOTEL CALL.

Of recent years a number of electrical or pneumatic devices for affording a speedy means of communication between the office and any room of a hotel have been introduced, some of which have possessed considerable merit, but all of which have possessed objectionable features, of one kind or another, sufficient to retard their general introduction. In some cases the apparatus has been too intricate, in others, too expensive; in others, requiring too much attention on the part of the occupant of the room, and so on. In some large hotels, also, speaking tubes are utilized between the various rooms and the main office, but these, apart from the high cost of construction, are also objectionable, by reason of the fact that in order to be satisfactory, a number of clerks must be on hand at the office to answer immediately all calls given simultaneously.

Perhaps the most satisfactory of such devices, of which, however, there have been but few introduced, have been those in which the general principle of the electric multiple call box has been followed, but the vastly greater number of "wants" to be transmitted to the hotel office than are necessary in the case of the ordinary district messenger service, has seemed to call for the exercise of ingenuity on the part of the inventor which has resulted in the production of systems much too intricate and scientific for the matter-of-fact service of a modern hotel.

Realizing the foregoing fact, Mr. E. M. Wilder, the well-known inventor of the Wilder fire-alarm system, the Wilder multiple call box, etc., has devised, and through the Wilder Hotel Call Company is now introducing a hotel call system, which, for simplicity of apparatus and ease of operation, it would seemingly be difficult to improve upon.

As an instance of its simplicity and adaptability to existing circumstances, it may be stated that this system is quite applicable, without any change whatever in the running of the wires, to the ordinary "push" button and annunciator call systems so extensively employed in all of the prominent hotels of the present time. Consequently, but one wire to each room and a neutral return wire are necessary in its operation.

The Wilder hotel call system may be described generally as follows: A dial form of transmitter, one of which is shown in Fig. 1, not much if any larger than the common multiple call box, is placed in each room in the place of the usual push button, the two wires ordinarily connected with that button being attached to the Wilder transmitter. On the face of the dial, arranged in a circle, are printed a large number of "wants," such as "boy," "coupé," "doctor," "bill," "ice-water," etc. On the present dials seventy-five different wants are printed, but any additional number could be readily arranged for. In this transmitter are contained a magnet and a large toothed break wheel, the purpose of which will presently be seen.

To procure any desired service, the occupant of a room, say, No. 24, places a pointer on the face of the dial over a given service and then pulls the crank in the usual way for sending in a call. This is all that is required of the occupant of the room. The pulling of the crank has the effect of closing the circuit leading to the annunciator, precisely as would the pressing of the push button, and consequently the hotel clerk is apprised that a given room has signaled him. The clerk thereupon inserts a metallic plug in a switch which transfers the circuit of room No. 24 from the annunciator to the circuit of a magnet contained in a box termed the "receiver," Fig. 2, and at the same time inserts into the circuit an extra battery. This extra battery has the effect of attracting the armature of the magnet within the transmitter, in room No. 24, and thereby causes the release of the large break wheel. This wheel is capable of causing 75 makes and breaks of the circuit. The number of such makes and breaks that it may cause, however, is regulated entirely by the distance from zero to which the pointer above referred to has been moved by the occupant in placing it over a desired want. In returning to its starting point it makes these specified makes and breaks and remains in its original position until the box has been pulled again by the occupant of the room.

The receiver in the hotel office is also provided with a dial and pointer similar to the dial and wants pointer of the transmitter, and having corresponding wants printed on its dial. The receiver is also provided with a large tooth or pin wheel, corresponding in size and in number of teeth and pins to the teeth of the break wheel of the transmitter. This wheel is given a tendency to rotate by an ordinary recoil spring, but its rotation is regulated by a step-by-step device controlled by the magnet in the receiver. As already stated, this magnet is placed by the action of the clerk in the circuit of any room desired. Normally, the point of the receiver which is mounted on the same shaft as the toothed wheel, is placed at zero. Thus if, for instance, room No. 24 should have desired "ice-water," and assuming that to place the pointer of the transmitter over "ice-water," the break wheel was moved 15 teeth past zero, it is clear that in returning to its starting point it will send in 30 makes and breaks. The circuit having thus been made and broken 30 times, it is obvious that the step-by-step motion of the toothed wheel in the receiver will carry its pointer around to the "ice-water" mark on its dial.

The annunciator thus indicates the room calling, and the receiver dial the nature of the service desired, of both of which the hotel clerk makes note, after which he resets the dial to zero, the act of doing which rewinds the recoil spring. The plug is then removed from the switch and connected with any other room that may, in the meantime, have called.

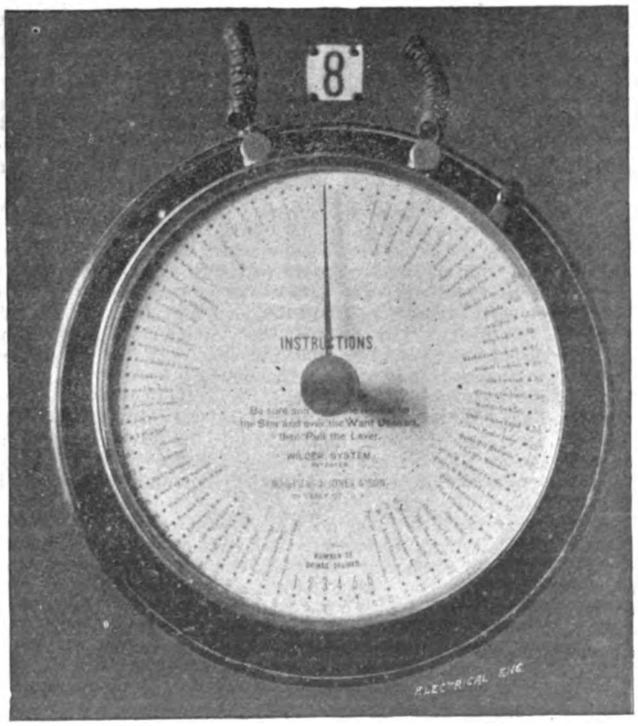


FIG. 1.—THE WILDER HOTEL CALL—TRANSMITTER.

It is thus obvious that any number of simultaneous calls from different rooms may be received in any desired order by the hotel clerk. The movement of the pointer back to its starting point is an indication to the occupant of the room that his call has been received. This system has the advantage that the pointer on the transmitter always returns to the point to which it has been set by the one calling, and thus any question as to proper fulfilment of an order is at once settled by a glance at the dial. Of course this call system is also applicable to apartment houses and other places where numerous different services are continually being demanded.

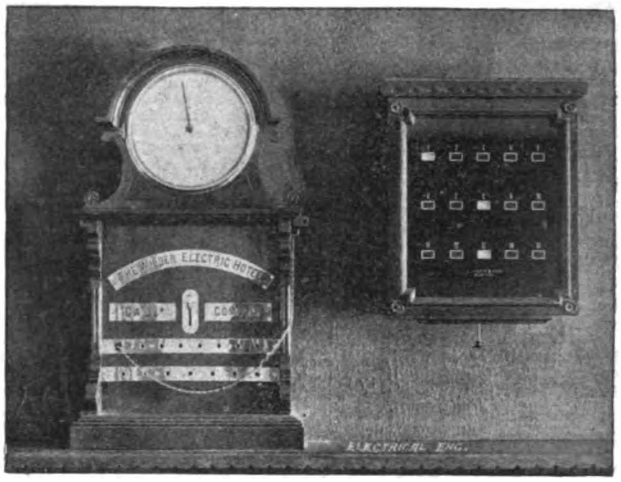


FIG. 2.—THE WILDER HOTEL CALL—RECEIVER.

We understand that arrangements for the placing of this call system in a number of New York hotels have already been completed. It is, we also understand, the intention of this company to sell these transmitters outright, waiving royalties, the simplicity of construction of the mechanism making it possible to manufacture the boxes at quite a low figure. The illustrations furnished herewith are from photographs of an exhibition installation in the main offices of the Wilder Hotel Call Company, Temple Court Building, New York City. The officers of the company are, E. R. Wilder, president; Chas. Shaw, vice-president; Charles J. Pearson, treasurer; L. F. Bostleman, secretary; E. E. White, manager.

Personal.

PROF. GEORGE FORBES, who departed from these shores but a few weeks since, is expected to return by Aug. 17 to look after professional work entrusted to his care on this side. Prof. Forbes' agent makes a brief announcement on this subject in our columns this week.

MR. FRED. RECKENZAUN the well-known electrician, has been spending some time in Chicago.

PHILADELPHIA NOTES.

ORDERS booked by Warren Webster & Co., manufacturers of the Webster vacuum feed-water heater and purifier during the month of July were as follows:

V. D. Anderson Co., Cleveland, Ohio, one 80 h. p.; Mechanical Fabric Co., Providence, R. I., one 400 h. p.; Carlisle Water & Gas Co., Carlisle, Pa., one 200 h. p.; Savannah Gas Works, Savannah, Ga., one 60 h. p.; Penna. Steel Co., Steelton, Pa., first order, one 400 h. p.; second order, one 2,000 h. p.; Detroit Sheet Metal and Brass Works, Detroit, Mich., one 125 h. p., for Telephone Building, Detroit; Onderdonk Heating and Ventilating Co., Philadelphia, one 80 h. p.; Mt. Holyoke Seminary and College, Holyoke, Mass., one 150 h. p.; J. Horace McFarland Co., Harrisburg, Pa., one 30 h. p.; Harrisburg Boot & Shoe Co., Harrisburg, Pa., one 150 h. p.; N. & C. Taylor Co., Philadelphia, one 100 h. p; D. M. Bare & Co., Roaring Spring, Pa., one 1,000 h. p; Lorraine Manufacturing Co., Saylesville, R. I., one 750 h. p.

The orders received for the Williames vacuum system of steam heating without back pressure upon the engine were as follows: Armour & Co., Union Stock Yards, Chicago, Ill.; Galloway College, Searcy, Ark.; Smith Building, Chicago, Ill.; Harrisburg Boot & Shoe Co., Harrisburg, Pa.; J. Horace McFarland Co., Harrisburg, Pa.

They issue a catalogue, and visit plants in any part of the United States at their own expense for the purpose of giving estimates under guarantee.

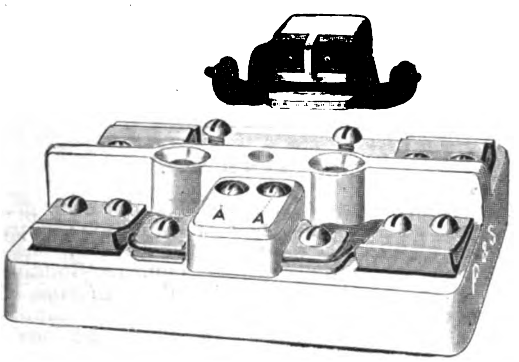
TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

It is good policy to strike while the iron is hot; it is still better to adopt Cromwell's procedure, and make the iron hot by striking.—E. L. Magvon.

PASS & SEYMOUR SPECIALTIES.

The accompanying illustration shows the Sawyer-Man main block, made by Messrs. Pass & Seymour, of Syracuse, N. Y.



Pass & Seymour's Sawyer-Man Main Block.

The brass work is mounted on Syracuse china and is furnished with or without the fuse plug as desired. The plug also serves as a cover for the fuse. To attach the fuse the screws A A are loosened and the fuse is fastened between the brasses. The plug is then inserted under the regular screws on the main block.

RECENT SALES OF PURITY OIL FILTERS.

The Purity Oil Filter Manufacturing Co. report that, in regard to sales, "July takes the bakery." They have sold filters recently as follows:

McIntosh-Huntington Co., one No. 3 Purity oil filter; Glens Falls Paper Mill Co., Glens Falls, N. Y., one No. 1 Ideal oil refiner; the Martine Cantine Co., Saugerties, N. Y., one No. 1 Ideal oil refiner; Granite Mountain Mining Co., Rumsey, Mont., one No. 3 Purity, second order in two years; Doylestown, Pa., Elec. Co., one No. 2 Ideal oil refiner; Yonkers, N. Y., R. R. Co., one No. 3 Eureka oil purifier; Wray Elec. Engineering Co., Bradford, England, one No. 2 Purity oil filter; Insane Asylum for Criminals, Fishkill Landing, N. Y., one No. 1 Purity; J. C. Hubinger Co., Keokuk, Ia., one No. 2 Ideal; Metropolitan St. R'y Co., San Francisco, Cal., Industrial Works, Bay City, Mich., one No. 1 Purity; Metropolitan St. R'y Co., Macon, Ga., Silver Bow, Montana, Elec. Light Co., one No. 2 Ideal refiner.

The following is a sample of the letters received by this company:

Purity Oil Filter Company,
Pittsburgh, Pa.

Lakewood, N. J., Aug. 3, 1892.

Dear Sir:—I have been using one of your No. 1, Ideal Steam Oil Refiners for four months past; I am very much pleased with it. I purify the oil from the engine and dynamo without any trouble. The refined oil is in splendid condition.

Yours very truly,
Mike McGravy
Engineer of Water Works and Electric Light Co.

"A MODERN TRIUMVIRATE."

This is not the catching title of a sensational novel, but is the term that has been very neatly applied to the firm of Bartlett & Co., of 21 and 23 Rose street, composed of E. E. Bartlett, the artist; Theo. von de Luhe, the engraver; and Louis H. Orr, the printer. These three talented gentlemen do not aim to run a government or wage a great war, but adapting the idea to modern notions they have ingeniously proposed to carry on and control a central station system for all the work that their individual and collective ability can be applied to. And the triumvirate, under these conditions, is a distinguished success, its work being a pride to all who order it and a joy to all who see it. The firm have applied the term, as quoted above, to an exquisitely beautiful pamphlet which illustrates in and of itself their work, the way it is done, and the place in which it is done. The engravings show the different processes actually going on, from the first to the last. The cover is a magnificent piece of embossing that will stay embossed, while the antique entablature inside printed in sepia is an art production worthy the best frame.

At the end of the brochure are a large number of well-deserved testimonials as to the work of the company.

WASHINGTON ELECTRIC CONDUIT COMPANY.

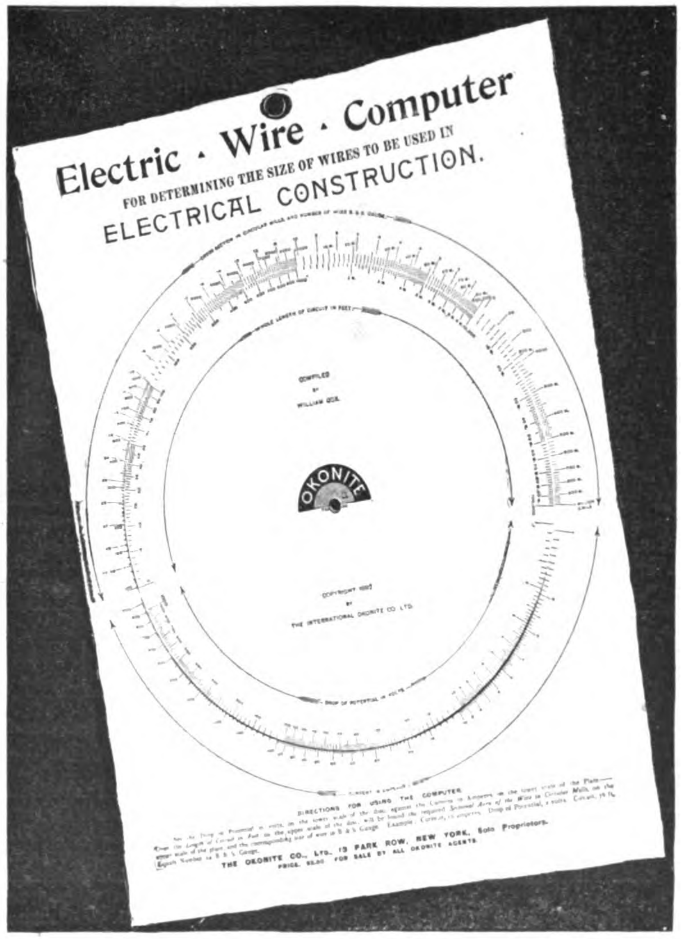
The president and general manager of this company, Mr. Wilmot Lake, reports most gratifying progress in the matter of contracts for electric conduits in different cities. Mr. Lake is at present busily engaged in laying about 10 miles of conduit in Washington, D. C., and has also just received an order for another to be laid in Albany, N. Y.; a number of other cities are rapidly falling in line, in view of the great and permanent success of all of Mr. Lake's installations thus far.

A NEW ELECTRIC WIRING COMPUTER.

We present to our readers a simple device just issued, and compiled by Mr. William Cox, by means of which the sectional area and the number of wire suitable for lighting and other purposes are at once obtained. It consists of a suitable foundation plate, with a revolving circular disc about 8 inches in diameter, both graduated in accordance with the factors of the formula whose solution it gives. This is the well-known one:

$$\text{C. M.} = \frac{l \times c \times 10.8}{V}$$

in which l = whole length of circuit in feet; c = current in amperes; v = drop of potential in volts; C. M. = sectional area of suitable wire in circular mils. The method of using this computer is shown by the following example in which we assume 76 feet as the whole length of circuit; current, 10 amperes, and loss, 2 volts. Turn the disc round until the division representing 2 volts is opposite, and coincides with, the one representing 10 amperes. We shall now find on the outer upper scale 4,100 circular mills, which corresponds to No. 14 wire, B. & S. gauge. This is, therefore, the number of wire suited to the circumstances.


Electric · Wire · Computer
FOR DETERMINING THE SIZE OF WIRES TO BE USED IN
ELECTRICAL CONSTRUCTION.
COMPILED BY WILLIAM COX.
OKONITE
COPYRIGHT 1892 BY THE INTERNATIONAL OKONITE CO. LTD.
DROP OF POTENTIAL IN VOLTS
DIRECTIONS FOR USING THE COMPUTER.
THE OKONITE CO., LTD., 13 PARK ROW, NEW YORK, Sole Proprietors.
FOR SALE BY ALL OKONITE AGENTS.

Cox's Electric Wire Computer.

We understand that Mr. Cox has sold his invention to the International Okonite Company (limited) 13 Park Row, New York, to whom all inquiries concerning it should be addressed.

STILL ANOTHER—AND THIS MAKES THE SEVENTH.

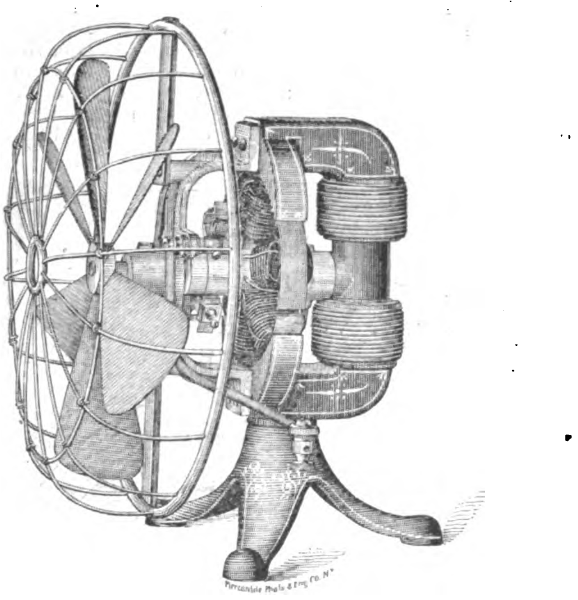
On Thursday, Aug. 4th, the "Kerite" Wire and Cable Co. placed across the Hudson another 18 conductor submarine cable. This cable, from shore to shore, is 5,300 feet in length. A small party accompanied the officers of the company to witness the laying of this cable, the ceremony, if such it may be called, occupying just five minutes from landing to landing. This was remarkable, but a beautiful and practically clear river facilitated matters so much that the record was beaten by several minutes. The cable tug "Western Union" was used in laying this cable, and has done similar service a number of times before. This cable makes the seventh 18 conductor cable furnished the Metropolitan Tel. and Tel. Co. by the Kerite Co. There is a moral here that is not hard to discover.

BALL ENGINES.

Mr. F. R. Chinnock, New York sales agent of the Ball Engine Co., of Erie, Pa., is located at 18 Cortlandt street, whence he constantly reports large sales of these well-known engines in all parts of the country.

EDISON BATTERY FAN MOTOR.

The evident demand for a fan motor operated by battery has led the Edison Manufacturing Co., of this city, to design the fan outfit shown in the accompanying engraving. This is wound to be run by four Edison-Lalande cells of the type "K" size, which are capable of furnishing current continuously for 100 hours. The cells, consisting of porcelain jars, are placed in lead-lined boxes 25 inches long, 8 inches wide and 15 inches high. The motor and fan occupy a space of 10 x 12 inches, and their workmanship is of the highest standard. The outfit can also be operated by one or two cells of storage battery.



Edison Battery Fan Motor.

THE INTERIOR CONDUIT AND INSULATION COMPANY.

The Interior Conduit and Insulation Company's business is increasing in a most interesting manner. In addition to the regular monthly increase in the manufacture of their conduit, the Lundell fan motor which they have brought out this season has met with wonderful success. Up to the first of the present month they had sold over 2,000. Their shops show remarkable activity. The recent heated term has seriously injured them, inasmuch as their mechanics were unable to stand the temperature of the building. During the first part of the week before last their superintendent, Mr. Pease, endeavored to supply every bench with a number of their Lundell fan motors. On Friday, however, the heat in the shops developed such a remarkable degree that the superintendent was obliged to shut down at noon and let the men off, as several had been overcome by the heat in the morning.

NEW YORK NOTES.

H. Ward Leonard & Co.—The position which is occupied by Messrs. H. Ward Leonard & Co. is one which is very popular with purchasers of electric railway and electric lighting plants. A "bulk" electrical contractor who undertakes the entire equipment of the plant, and turns it over to the purchaser complete in every respect, relieves the purchaser of a great deal of responsibility and annoyance, and insures the rapid execution of the work, without the division of responsibility which always is met with when various contractors are operating upon the same plant.

It is not often that an electrical contract of $800,000 is awarded. Hence there has been a very severe competition over the contract for the equipment of 17 miles of road for the Cayadutta Electric Railway Company. The contract has been finally awarded to H. Ward Leonard & Co., of New York City, who act as bulk electrical contractors for the entire equipment of the road including buildings, steam plant, electric generators, track work, bridges, overhead work, cars, etc.

The Fitch Battery and Electric Co., of Oneida, N. Y., have received notice that the Perfect battery, manufactured by them, was used with very gratifying results, in connection with the exhibition of the system of the Electric Heat Alarm Co., of Boston, recently given in St. John, N. B.

WESTERN NOTES.

Mr. Campbell Scott, of Louisville, Ky., formerly manager of the Cincinnati and Louisville offices of the Edison Company, having recently resigned his position to embark in business for himself, has opened an office in the Commerce Building, Louisville, and will hereafter represent, in Southern Indiana, Kentucky and Tennessee a number of the leading electrical manufacturers. Among them are the Detroit Electrical Works, National Electric Manufacturing Co., Card Electric Motor and Dynamo Co., John A. Roebling's Sons Co., Indiana Rubber and Insulated Wire Co., Union Electric Co., Electric Appliance Company, Buckeye Electric Co., besides a number of other manufacturers of electrical specialties and supplies, boilers, engines, etc.

Charles E. Brown, of the Central Electric Company, met with a rather painful accident last week; in adjusting a fan motor the blade of the fan struck him on the back of the hand, cutting a gash to the bone almost an inch wide. Dr. John McKinlock, the surgeon of the company, promptly dressed the wound, and there will be no occasion for serious results therefrom. Mr. Brown's hand will be in a sling, however, for some little time. In the meantime, if his friends in the trade feel slighted when they call, by not being able to grasp him by the hand, it will be due to the above circumstances.

The Gate City Electric Company, the Kansas City branch of the Central Electric Company, have sold to Armour Brothers 10 miles of Okonite and 10 to 20 miles of weatherproof wire, besides other supplies for their new buildings. The order was given on the merit of the goods, and was handled with a good deal of skill by Mr. W. D. Green, the manager at Kansas City. The Central can be congratulated upon having such a capable man in charge of their Kansas City house.

The Electric Appliance Company, Chicago, report large success in the introduction of Mica-Asbetite railway appliances. This material is receiving favorable comment from every one familiar with the requirements of electrical railway construction and a large number of Western railroads are giving the material the severest test with the best possible results; from which it would appear that the Mica-Asbetite appliances will take their place among the standard railway material on the market.

The Sioux City Electrical Supply Co., Sioux City, Ia., have added $12,000 to their paid-up capital. They are now operating a brass foundry, making a specialty of casting electrical goods, but also doing a general jobbing business in casting copper, lead, zinc, tin, aluminum and antimony, making solder, babbit, commutator bars, etc., for the trade.

The Kester Arc Lamp and Manufacturing Co., although they have only recently placed their new lamp for constant potential circuits on the market, are receiving a large number of inquiries and orders. Their lamp is handsomely finished, very reliable and economical in the use of current and a large business will no doubt be done.

Wickes Bros., manufacturers of boilers and engines, No. 510 Monadnock Building, Chicago, Ill., are doing quite a large business through Mr. A. M. Castle, manager of their Chicago office. They are handling Wood water tube boilers which are adapted for central stations, both lighting and street railway.

☞ *Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.*

THE
Electrical Engineer.

Vol. XIV. AUGUST 17, 1892. No. 224.

VACUUM LIGHTNING ARRESTERS.

BY

Lewis Searing

IT has been almost invariably the rule in devising lightning arresters to regard the arcing of the line current as a necessary evil and all invention has been directed to devices for breaking this arc, instead of preventing it. The writer having a very strong belief in the old-time adage that "Prevention is better than cure," directed his efforts to the seemingly impossible problem of discovering a means for *preventing* this arc.

Lightning, or more properly speaking, the static discharge from aerial lines, is not of a damaging character as it usually manifests itself in central station apparatus. It is the powerful heating effects of the dynamo current which follows over the static spark, a space it would be impossible to jump by virtue of its own E. M. F. It is not such a difficult matter to provide a path to the earth for the charge which may accumulate in a line, but it *is* difficult to prevent the dynamo current from following the same path. This is especially so in an electric railway circuit where one side of the line is already grounded, for connection to the ground at any one point results, virtually, in a short-circuit.

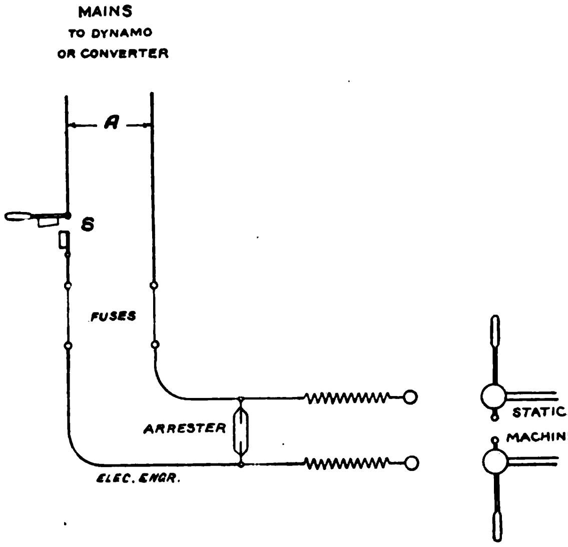
Take, for instance, the usual electric railway circuit of 500 volts, arresters formed of two carbon plates separated by a space of $\frac{1}{64}$ inch; one plate connected to the line and the other to the ground, would easily take care of all the lightning that might come on the line. But the first time a discharge took place across the arresters the dynamo current would follow, and unless interrupted by a fuse in the ground side, would completely unfit the arrester to take care of the next discharge which would be pretty sure to come immediately if the arresters are out of order. It would be a simple matter to prevent the arcing of the dynamo current by separating the carbons by a distance of six inches, but as an easy path to the ground for the lightning, in preference to a costly machine, this would be manifestly absurd.

In view of these facts one naturally seeks to find in the perfect lightning arrester, a medium of great conductivity to a static charge and a medium of great resistance to a dynamo current. A review of the various phenomena accompanying the static spark and the arc as occurring in different mediums led to the adoption of a rarefied gas as the most promising solution to the problem, and experiments were made to test the correctness of the theory and to obtain a practical form of apparatus. The arrester first experimented upon was nothing more than a glass tube three-quarters of an inch in diameter, into opposite ends of which were let platinum wires terminating in carbon points separated by a space inside the tube, the latter being exhausted by air and sealed.

The method of testing is shown in the diagram. The wires from the arrester terminated in metal balls mounted on one glass tube to enable both ends of this circuit to be connected quickly and simultaneously with the poles of the static machine, for otherwise with the arrester directly connected to the machine the leakage across the arrester and through the dynamo prevented the machine from charging itself to any degree.

The arrester being placed in position, the switch completing the circuit from the dynamo to the arrester was closed and the static machine turned by hand until fully charged. The terminating balls of the arrester circuit were then suddenly placed on the poles of the static machine, causing a disruptive discharge to take place across the arrester points.

In the first experiment the space between the carbon points of the arrester was six-tenths of an inch and the voltage at A, 1,000, alternating. The arrester being in position, the switch S was closed and before the terminating balls had approached close enough to the poles of the static machine to produce even a visible discharge, both fuses were blown.



Testing Vacuum Lightning Arresters.

The explanation is simply that the points were so close together that it required but a very slight static discharge to carry over the current from the dynamo. The arrester was not injured, although there was evidence of an arc having been formed across the carbon points.

An arrester with a separation of but one-tenth inch was next tried. The fuses blew upon closing the switch S, showing that the voltage of the dynamo was sufficient to arc across this space; with the arrester of six-tenths inch separation and the voltage at A reduced to 150, discharge after discharge from the static machine could be made across the arrester points without the dynamo current following. Raising A to 240 volts was sufficient to make the current follow over and blow the fuses.

By connecting two converters together so as to bring the primary coil to the arrester, it was found that an arrester with a separation of one and seven-eighths inch, and a voltage at the arrester of 650, the converter was completely protected, although connected to the arrester by but a few feet of wire. By raising the voltage of the converter until a luminous discharge was produced between the points and at the same time discharging from the static machine, the converter current showed no inclination to *arc* across.

It is therefore evident from these experiments that it is not impossible to obtain a medium which shall at the same time form an easy path for the lightning and resist the passage of the line current. Substitute plates for points so as to promote a brush discharge, and surround the plates by a rarefied atmosphere of a non-oxidizing gas and we obtain an arrester which is at once perfectly automatic and weather-proof, contains no moving parts to stick and get out of order, is inexpensive and effective.

VACUUM TUBE LIGHTNING ARRESTERS.

BY

Reginald A. Fessenden.

I HAVE to thank Mr. Osborne for his letter in THE ELECTRICAL ENGINEER of July 27, but must disclaim the credit of having been the first to suggest the use of vacuum tubes in this connection. The idea was suggested to me by Mr. John F. Kelly, who informed me at the time, that vacuum tubes had been used as lightning arresters on telegraphic lines a number of years ago. The fact that the experiments to determine the best vacuum to be employed were made by me and that the apparatus was put in practical shape by Mr. Nassoy and myself, is what probably gave rise to the mistake.

En passant I may speak of the reasons for designing such an arrester. It is not advisable in practice to insulate a 110-volt dynamo so that it will stand much more than 500 volts, as if this is done, the insulation takes up too much room. This corresponds to a sparking distance of less than five one-thousandths of an inch. It is therefore evident that if the potential between line and ground is more than 500 volts and the jaws of the lightning arrester are farther apart than five one-thousandths of an inch, the dynamo may be burnt out, and yet the lightning arrester fail to work. It might be thought that this is a rather problematic case, but it is by no means so; while, if a sudden difference of potential is made between line and ground, the lightning arrester is almost sure to work. It is one of the commonest things in the world for the potential on the line to creep up slowly, even on days when there is no lightning to be seen, till it gets a chance to spark across somewhere. As the charge creeps up slowly, no amount of self-induction will keep it out of the machine, and unless the air gap of the lightning arrester breaks down before the insulation of the dynamos, there is trouble.

The common statement of the engineer (one at least, which I have met with three times myself,) in such cases is, "There was no lightning to be seen and not very much rain, only a drizzle; I got a shock from the water-pipes several times during the day. When the dynamo (or dynamos) went up, the lightning arresters did not work, though we have them on all our lines. They are in good order and have worked very well on previous occasions." It was for this reason that the vacuum tubes were used as lightning arresters, as by altering the vacuum they may be made to go off with certainty at any desired potential.

I may say that I have designed another form of lightning arrester which is simple and more certain than the above, having no air gaps, but depending on the properties of a certain chemical substance. This will shortly be put on the market, but as the patents have not yet been issued, I must defer explanation for the present.

SHALL IT BE "CONTINUATOR" AND "PULSATOR"?—A SUGGESTION.

BY

L. Gutmann.

FOR some time I have been wondering why there are no short terms for a "continuous current generator" and a "pulsating current generator." Considering the great length of time that these machines have been in use, an appropriate short name, so it seems to me, would have been desirable. A great contrast seems to exist in this respect in alternating current apparatus. Not only have the dynamos of this type after having been discarded for a number of years, suddenly swept the whole globe, but also within the six years of their renewed existence a short name seemed desirable, such as proposed by Mr. Mordey, I believe. Instead of the "alternating current dynamo" the new name has become so familiar to us that we did not wait for an electrical congress to formally adopt it. We find the name "alternator" even adopted by Prof. Thompson in his latest edition of "Dynamo-Electric Machinery."

Not knowing whether other engineers think it necessary to introduce new names for the other dynamo types, or whether a subsequent discussion would not disclose more appropriate names, it would be desirable to hear the opinion of other engineers through THE ELECTRICAL ENGINEER before proposing such a name to the American Institute of Electrical Engineers, which body should be the court of last resort to finally accept or reject such propositions for the United States.

One of the main points in coining names is harmony, and it occurred to me that the new names must be of a construction similar to "alternator" to be acceptable. The name "commutator" would have been the best for a continuous current machine if it had not been adopted long ago for the mechanical device used as a portion of a continuous current machine for directing the current or changing the circuit connections of the various impulses. The next best name seems to me to be "continuator," and similarly, "pulsator," so that we would have for the alternating current dynamo, "alternator;" for the pulsatory current dynamo, "pulsator;" and for the continuous current dynamo, "continuator." I hope that electrical engineers will give expression to their views on this subject.

THE ELECTRICAL PRODUCTION OF OZONE.

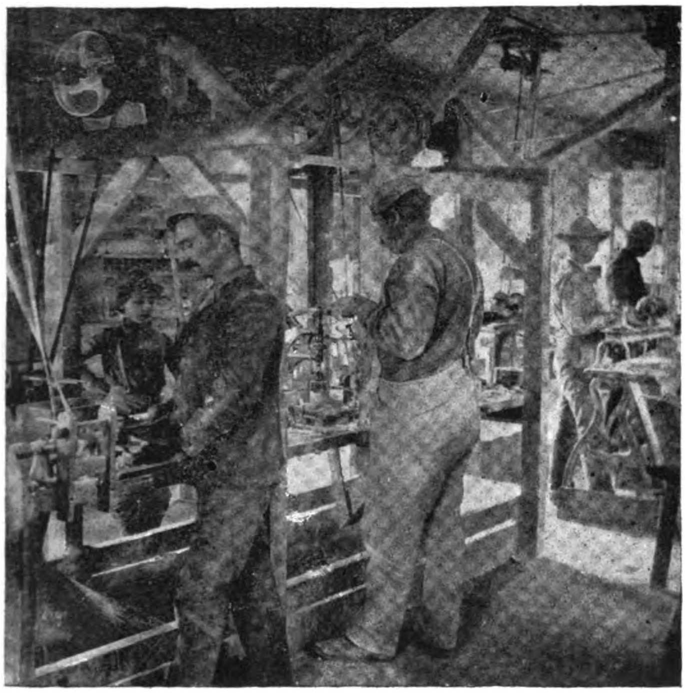
ONE use of ozone, on which Herr Frölich lays special stress in a recent lecture, is the disinfection and sterilization of water. From recent experiments in the Siemens and Halske laboratory at Berlin, it appears that good results have been attained in producing ozone on a commercial scale by means of the silent electric discharge. An apparatus now at work in the laboratory yields 2.4 mg. of ozone per second. Experiments are being made in supplying compressed ozone for technical use; and this has been accomplished with a pressure of nine atmospheres.

AN ELECTRIC WAGON.

TRIAL was made in Chicago recently of a park wagon equipped with a small 3 h. p. motor and a twenty-four-cell storage battery. With five persons in the wagon, it left the barn of the American Battery Company, on Monroe street, and traveled by the way of Winchester avenue to Jackson Boulevard, to La Salle street, to the company's office at Monroe and La Salle streets. The run was made in twenty-two minutes. After a few minutes another party made the return trip. It is calculated that the wagon can make ten miles an hour easily with the present motor, and can climb any hill in Chicago.

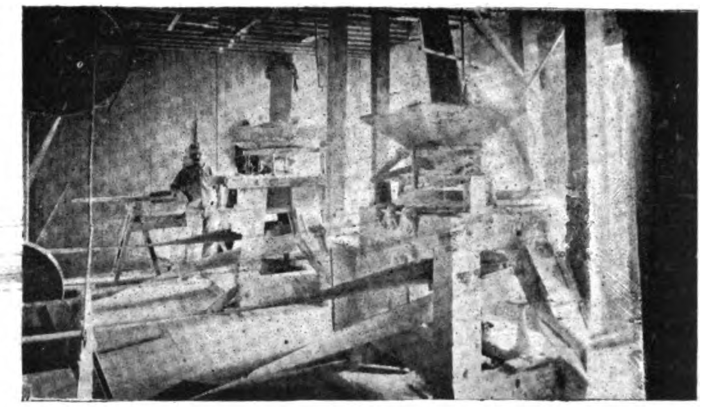
THE MAKING OF LAVA INSULATORS AT CHATTANOOGA, TENN.

LAVA insulators have won a distinct place in the electrical arts in this country, and each year sees some new application of this interesting form of insulation, wherever exacting conditions with fire and moisture have to be contended against. Lava seems to be equal to glass, porcelain and mica in its ability to withstand considerable electrical strain, while it lends itself readily to manipulation into an immense variety of shapes, especially for small parts of apparatus. It can be turned, cut or molded into any shape required, before being submitted to the hardening process, and so little susceptible is it to warping while going through the treatment for hardening that it will fit into any given place for which it was designed with the accuracy of brass or other metal. This fact offsets, or, rather, emphasizes the other quality it has of extreme hardness, as the result of which its bearing parts, or its threads, in any apparatus, remain for an indefinite time without perceptible wear; so that while other portions of the machine or instrument may need renewal, the details made in "lava" may be employed over and over again. "Lava" is not soluble in any known acid, it is waterproof and nonabsorbent, and it is absolutely resistant of heat. Any ordinary temperature that may be met with, where the parts are in contact with fire, does not hurt it in the least. The writer has seen pieces that have stood a continuous exposure of thirty hours surrounding a 2,000 c. p. arc, being part of the time practically in the arc; yet the impression, if any, made on the rings used was really undiscoverable. The insulation resistance is also extremely high. A piece of about a cubic inch tested by the Thomson-Houston Electric Co., who have used enormous quantities of lava, is reported to have shown a resistance of 50 megohms.



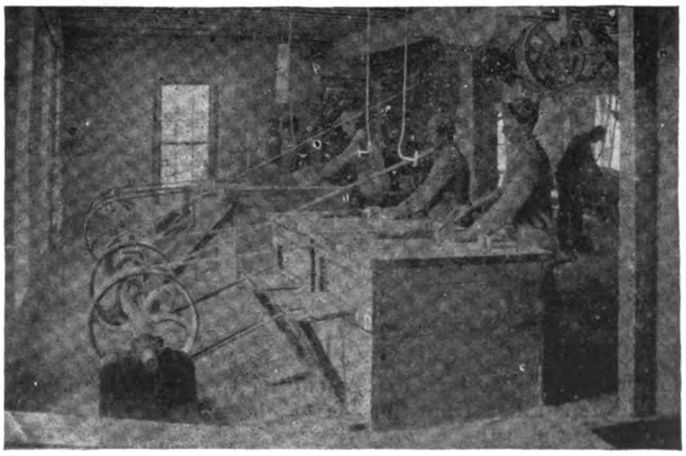
Machine Work in Insulator Department.

It is natural that with the qualities roughly outlined above, "lava insulation" should have made its way in the electrical field since its introduction a few years ago. At the present time the consumption is very large, as many as half a million pieces having been ordered in a single week. There are one or two substances that have renewed in electric lighting work a popularity already won in the domain of gas, and lava has certainly been among them. The number of lava gas tips in use now runs up into millions, and so long as gas is used there is no reason to doubt that the demand will grow.



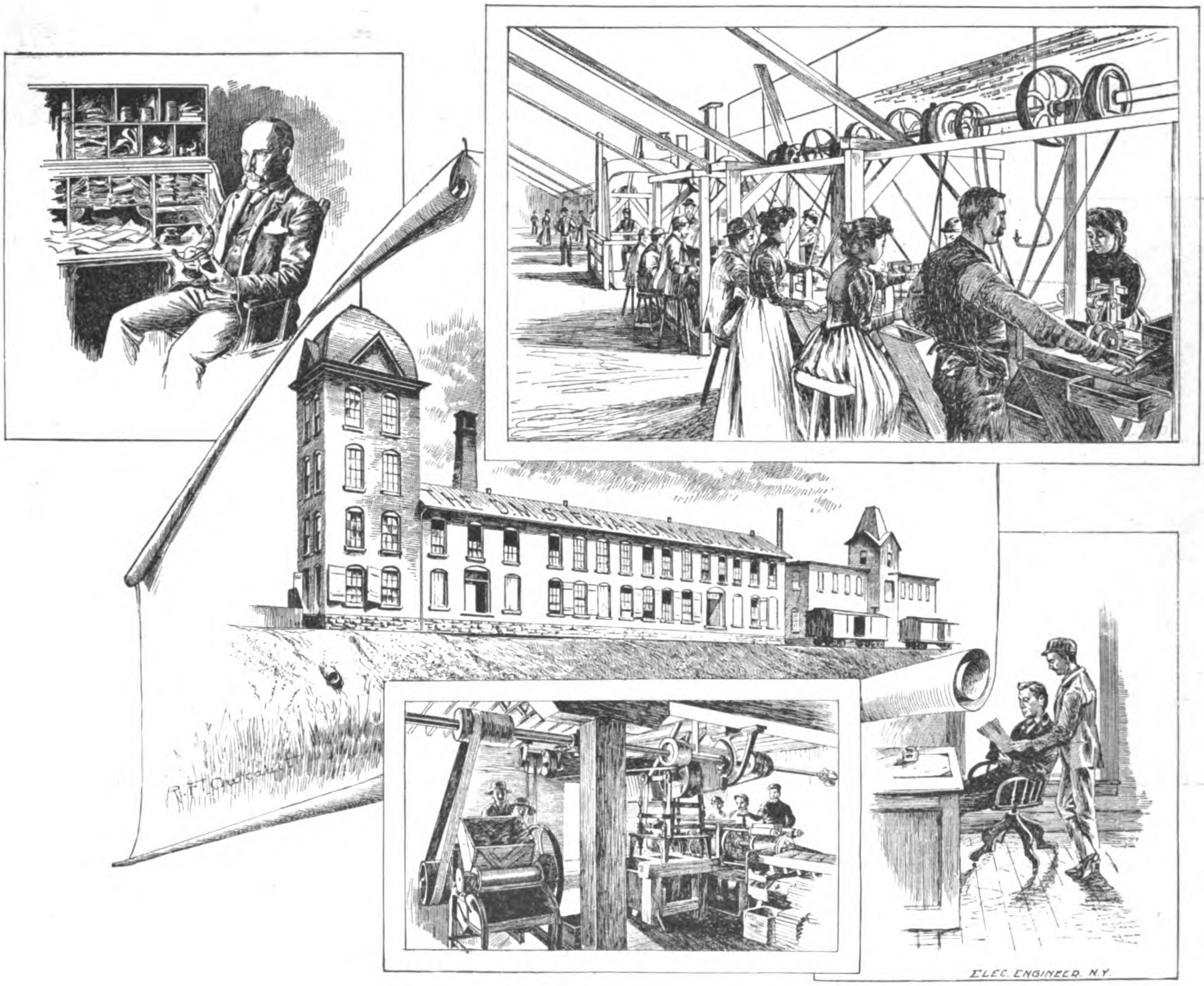
Part of the Mill Room.—Grinding Steatite.

The basis of "lava" is steatite or soapstone, of which the lava manufacturers D. M. Steward & Co., of Chattanooga, Tenn., have a remarkably fine mine. The same material is worked up into the millions of dustless crayons and slate pencils used in this country every year, and hence is a standard article of diet not only with the savages of South America, but with the gentle school children of North America. Before establishing himself in Tennessee, where he is near his source of supply of raw material, Mr. D. M. Steward carried on his industry for several years at Cincinnati. It is a singular fact, and one that tells volumes of the changed social and industrial conditions of the New South, now so warm in its welcome to manufacturing enterprise, that when he removed from Cincinnati, Mr. Steward, an old Union soldier, built his factory on the very ground where he had camped and bivouacked during the struggles of the civil war. The people with whom he had fought were not less glad to extend him the hand of comradeship than was he to settle among them as a citizen, with his energy, capital and experience. Perhaps if Mr. Steward had not gone fighting



Cutting Blanks for the Lathes.

through Tennessee he would never have known what a Land of Promise awaited in the South when the piping times of peace could come round again.


ELEC. ENGINEER N.Y.

Views at the Factory of D. M. Stewart & Co., Chattanooga, Tenn.

Taking the crude steatite as it arrives from the deposits in the mine—a pinky-white rock, soft and smooth to the touch like polished wood, or plumbago—it is first necessary to reduce it to powder. In the large factory of which a view is given in our illustrations, Mr. Steward has a complete equipment for this and all the subsequent stages of the work. The rock is ground to powder by passing it through an ordinary stamp mill, of the kind familiar in mining regions. The powder is then carried by chain conveyer to the mills proper. Here it is ground exceeding small, so that one can hardly feel it when rubbing it between the fingers. This second powder, to which the word "impalpable" might be fairly applied, is then conveyed by elevators to the bolts, where it passes through the finest silk bolting cloth. From these bolts it is deposited in large bins or settling chests, whence it falls to the lower floors again. It is taken from the receptacles and placed in revolving mixing tubs, where the mass is treated with liquid chemicals which reduce it to a condition in which it resembles bread dough, and is so little American that it is entirely and absolutely free from grit. Leaving the mixers, it is passed to the rolls, where it is repeatedly pressed, and it is again pressed in special machines, operating under great hydraulic pressure, in which the dies are placed for turning out the blanks for the lava insulators. The dies are changed in the hydraulic press from time to time, in keeping with the size or class of insulator to be made. In many instances, of course, the pieces require careful and expert cutting and working, as illustrated in our engravings, so that they may be finished. The smallness of the holes that can be made in the "lava" and the fineness of the thread, are something remarkable.

After the sawn or pressed pieces have been prepared, they are subjected to the hardening process, by being placed in a kiln into which superheated steam is introduced in pipes, the temperature being regulated by the requirements of the article subjected to its influence. On leaving the kiln, the articles are examined, finished and packed.

Where the work is of such variety as in the case of lava insulators, the details of the process are many, though they do not greatly differ, the one end being uniformity and accuracy. Some of the pieces made are extremely small, others are quite large, and the range extends all the way from rings and washers, and cores for little magnets, up to long tubes for interior and underground work, and insulators for overhead trolley wires. Mr. Steward and his two sons, G. C. Steward, assistant manager, and Clarence S. Steward, superintendent, who superintended the work, have incessant inquiries for insulators which are intended and expected to stand the severest possible tests and to come out of the fiercest ordeal as fresh and smiling as the Hebrew youths of old from their bath of fire.

In view of the conditions that prevail in the South, with its equable climate, cheap labor, and nearness to iron and coal, it is somewhat singular that so little electrical manufacturing has been done in that region. But it is cause for congratulation that Mr. Steward, as an old Northern manufacturer, has been able to transplant his important industry and carry on there with renewed and growing success his production of a very interesting and useful detail of electrical work.

The buildings have a combined frontage of 450 feet. About 25 tons of material is used every week.

HIGH VOLTAGE INCANDESCENT LAMPS.

BY

Capt A. de Khotinsky

In The Electrical Engineer of July 27, in the notes on 200-volt incandescent lamps, taken from *L'Industrie Electrique*, M. Vitte cleverly suggested making 200-volt lamps from 10 c. p. 100-volt lamps by simply doubling the length of the filament, for which suggestion lamp manufacturers should be very thankful for such an easy solution of the question of high voltage lamps. As I see from your editorial note that there is great interest manifested in electrical circles in high voltage lamps I take the opportunity of giving a short review of my work in that line.

In 1881, when I was in Paris, Mr. H. Fontaine, president of the Gramme Electrical Co., gave me a problem to solve in the construction of high voltage lamps of 250 volts and 200 c. p., limited to absorb not more than 600 watts; his idea was to replace the Jablochkoff candles on the Avenue de l'Opéra. I made several dozen of these lamps which were submitted to the committee appointed by Mr. Fontaine, consisting of Mr. Gramme, and his brother-in-law, a professor of chemistry in Brussels College; Mr. Niaudet and others.

The result of this test was favorable in all respects, as regards the efficiency and electrical part, but as the committee found it very difficult to watch the lamp during 300 hours (which was stipulated as the necessary life) they determined to test the lamp only six hours, but with 300 volts difference of potential. The highest life under this condition was 5 hours and 40 minutes, and for this reason the lamps were rejected; and that was the end of my first experiment with high voltage lamps.

During this test the lamps did not blacken on the inside surface of the globe, only a small blue flame was seen on the positive terminal of platinum near the connection of the filament, which flame, a few minutes before it ruptured, jumped many times from one terminal to the other and at last short-circuited and melted the platinum below the negative terminal of the filament, and in all cases the filaments were left intact.

The distance between the terminals was 1¼ to 1½ inch and the length of filament 18 inches in each, two filaments being employed in multiple which crossed each other at an angle of 90 degrees. The filament was punched out of bristol board, and had a section of 400 square mils; the form of the filament was zig-zag, similar to the Weston 100 c. p. filament of 1883.

In 1882 I found it possible to prepare a homogeneous material for manufacturing filaments which, after carbonizing, gave a carbon of specific gravity equal to 1.45. In 1883 I formed a company in Rotterdam, Holland, and built a factory to manufacture my high voltage and high efficiency lamp, but, I am sorry to say, the market at that time was not ready to accept my products, or, I had better say, there was no use for them, because in Europe at that time all central stations were comparatively of very limited extent, and the question of economy in copper with high voltage lamps was not appreciated; and, in addition many central station men would not bind themselves to buy from a single manufacturer. These circumstances again stopped high voltage lamps and I was obliged to manufacture ordinary lamps up to 110 volts.

In 1887 I had an opportunity to introduce my high voltage lamps in Block Station, Neue Friedrichstrasse, Berlin; this station had a capacity of 1,200 lamps 160 volts, from 10 c. p. to 150 c. p. each; this station is working at the present moment.

In 1888 I made a contract to light a part of the Brussels Exposition with 600 incandescent lamps and 18 arc lamps, all on a 155-volt circuit; and for my high voltage lamps and entire plant I received a gold medal and diploma of honor. In the same year my proposal was accepted for lighting part of the town of Reims, France, on the three-wire system at 320 volts potential, and in September, 1888, this plant of 1,200 lamps was put in operation and is working now with lamps of from 10 to 32 c. p. and 155 volts each. In 1889 Mr. Medhurst installed 2,000 lamps of 160 volts from 16 to 250 c. p. in the cotton mill at St. Petersburgh and many hundreds in South Russia, all working with Parson's turbo-electric generator.

In the summer of 1889 there was a demand for my 220-volt lamp in Marseilles, France, and Barcelona, Spain, where they were employed on the three-wire system, 420 volts being the total pressure. The drawback to the high voltage lamp was, that I was the only manufacturer of those lamps, up to the time of my leaving Europe for this country in December, 1891.

My company, in Europe, gives an absolute guarantee of 1,000 hours for the lamps of 3½ watts up to 220 volts, and the practice of five years proves that the average life is between 1,000 to 1,100 hours. Lamps of high voltage are certainly more expensive to manufacture and they cannot be sold for the same price as an ordinary 50 or 100 volt lamp, but the difference is not so great, being only about from 15 to 25 per cent.

The increase of price in manufacturing consists of platinum hooks by which I attach the filament to the globe, similar to that shown in the engraving in the Engineer of July 27, and also from the extra care with which this lamp must be manufactured.

Regarding the brush discharge between the terminals of the filament, I succeeded in reducing it to practically nothing, by special care introduced in the mode of manufacturing. I must say that the brush discharge cannot be annihilated by increasing the distance between the carbon terminals, as suggested in the editorial notes, because according to my practice the brush discharge depends mostly on the degree of vacuum, the nature of vapor in this vacuum, resistance of contact between filament and leading-in platinum wire, quality of glass from which the bulb is blown (quantity of metal oxides in the glass) and the specific resistance of the filament.

THE POLYPHASE CURRENT IN FRANCE.

According to the *Revue Internationale de l'Electricité*, MM. Guitton and Bertolus, owners of the Oerlikon patents for France, have concluded a thirty years' electric light and power contract with the municipality of Romans. They propose to use a 1,000-foot fall, 17 miles distant from the town, and to employ polyphase currents. The Edison Company of Saint-Etienne also intends to adopt the polyphase system in carrying out the large transmission and distribution of power scheme voted by the municipality. Near Montpellier a 200 h. p. fall is to drive polyphase dynamos supplying current to a group of villages.

MODERN AMERICAN TELEGRAPHIC APPARATUS.—VI.

BY

A. H. Jones

AMERICAN telegraphy being controlled and operated by private enterprise subordinates everything to speed and good service, as there are no barriers against competition, such as would exist under governmental control, at any moment the public finds the service of existing companies unreasonably dilatory or costly. Hence, in every important commercial city of the United States, branch telegraph offices are established in the offices of news associations and newspapers and in the centres of the various districts in which particular commercial transactions predominate; and such branch offices are placed in direct communication with similar offices in other cities for the purpose of minimizing the time of telegram transmission.

In each city there exists, of course, one central office in which all the principal apparatus is placed and where the electric currents are furnished for the operation of all the wires; and the branch offices, as a rule, are simply connected locally by wires called loops, or legs, to apparatus which effects the transmission of the messages. Thus, the two sending and two receiving local circuits of a quadruplex set are extended by legs to the desired branch offices, so that the four operators at the branch offices may be in direct communication with the distant city, just as if they were sitting at the apparatus in the main office. At the latter place the only attention needed is given by the chief operator, who keeps the instruments properly adjusted and the wires in working order.

In applying dynamo currents to local loops and legs between the central office and its branches economy and rapidity of operation require an automatic and compact system. The following methods, adopted by the Postal Telegraph-Cable Co. meet these conditions, placing the switches under direct control of the chief operator, and relieving the memory from every possible burden, so that the currents preserve a uniform strength at all times. Any set of quadruplex or duplex may be very quickly connected with any other set, or any single wire may be attached to work upon one side of any quad or on a duplex, or branch offices may be as quickly changed from one set to another, and in either of these changes it is necessary only to employ one dynamo, with a voltage high enough to work the loop or leg having the highest resistance, all others having their resistances graded by artificial resistance to correspond.

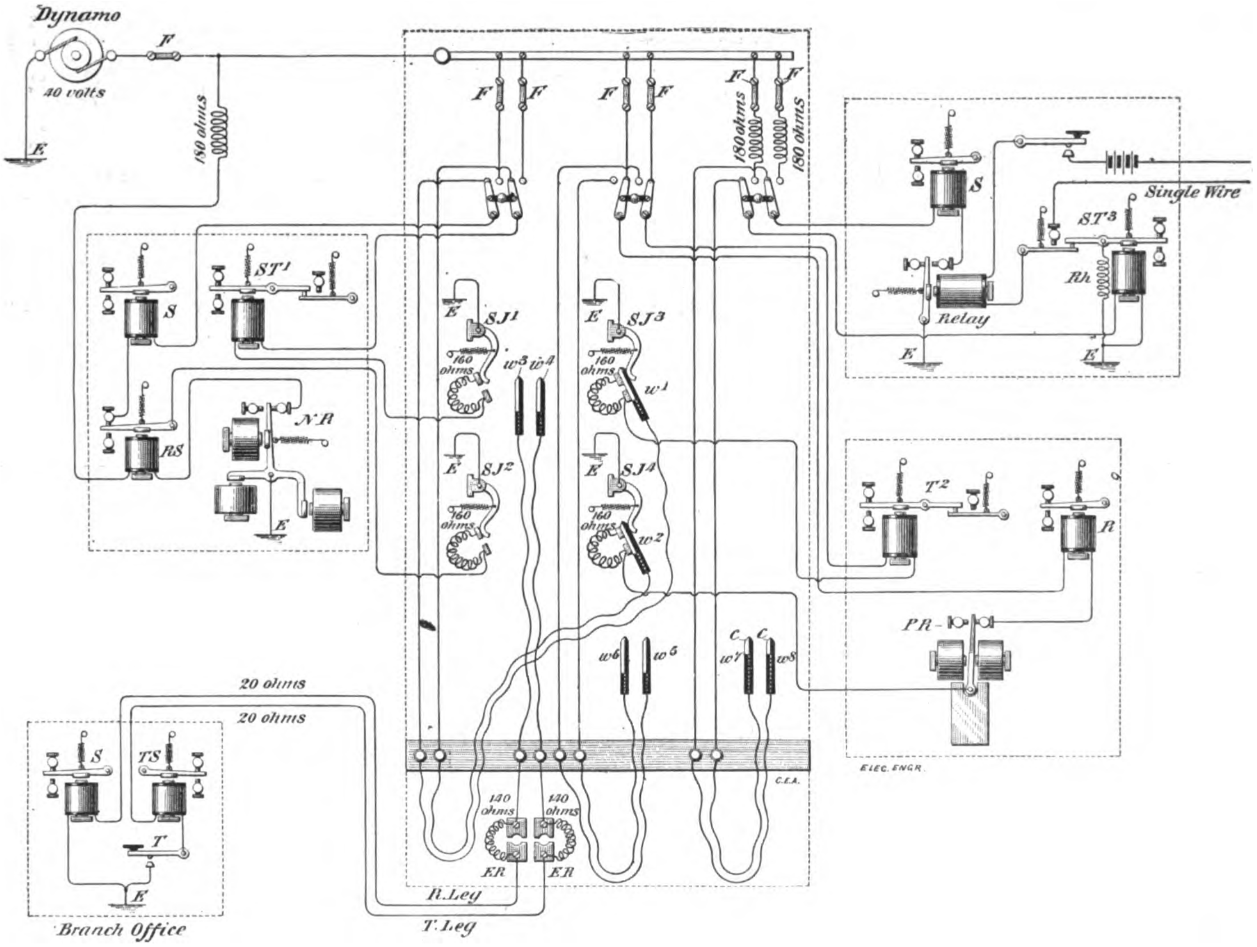


FIG. 1.

In the accompanying diagram, Fig. 1, the largest space inclosed by dotted lines represents a switchboard fitted with spring jacks, double three-point switches, flexible cords with wedges, and inductanceless resistance coils as previously described. Only two sets of jacks S J¹, S J² and S J³, S J⁴, are shown. The dynamo current is brought to a bar on the switch and the connections are made via the fuses F as will be readily understood by inspection. In the upper left-hand space inclosed by dotted lines is the No. 2 side of a quad set, and in the lower right-hand space is a duplex.

The letters represent the various instruments as follows:
F, fuses;
S T¹, single transmitter of No. 2 side of quad;
T², pole changer of duplex set;

ST^3, single transmitter of half of Toye repeater;
W R, No. 2 or neutral relay of quad;
P R, polarized relay of duplex;
S, ordinary 20-ohm sounders;
R, ordinary 20-ohm sounder of duplex set;
R S, Edison bug trap repeating sounder;
S J^1, jacks connected to the transmitter of quad set;
S J^2, jack connected to sounder of quad set;
S J^3, jack conneced to pole changing transmitter of duplex;
S J^4, jack connected to polar relay of duplex;
R H, resistance of Toye repeater;
T S, transmitting sounder of branch office;
T, sending key of branch office;
w^1 and w^2, wedges for connecting quad set;
w^3, w^4, wedges for connecting branch office;
w^5, w^6, wedges for connecting duplex set;
w^7, w^8, wedge for connecting single wire;
R leg is for reception of signals at branch office;
T leg is for transmission of signals from branch office.

The diagram shows the transmitter of the quad set connected through one of the double three-point switches with the polarized relay of the duplex, so that the signals of the latter are sent forward over the quadruplex circuit, and the transmitter of the duplex is shown connected with the repeating sounder R S of the quad, whose signals may be transmitted over the duplex. The wedges have one side insulated as indicated in black. The electromagnets of the transmitters and sounders have a resistance of 20 ohms each.

It will be seen that the branch office may be included in the local circuits by inserting wedges w^3 and w^4 in the jacks S J^1 and S J^2 so that it is possible for the distant offices to have one direct communication, and another with the repeater office or the branch office at the same time. Or a communication from one terminal office may be copied by the three other offices. By using wedges w^7 and w^8 the connections of which, C C, are shorter than those on the other wedges so that they will not cut out the equalizing resistances of 160 ohms under the jaws of the jacks, the single wire may be connected on to any duplex or one side of any quad, so that one communication may be had between an office on the single wire and the distant office on such circuits.

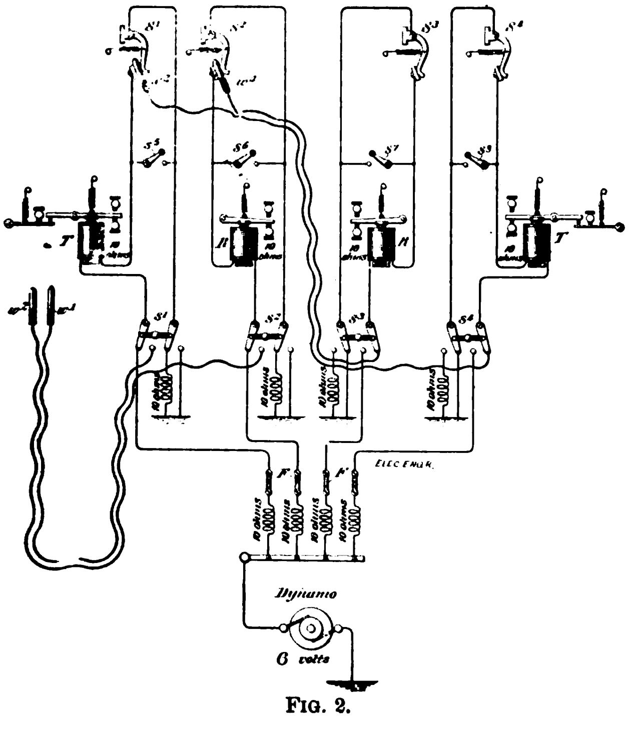


FIG. 2.

Fig. 2 is a modified arrangement more particularly adapted to repeater offices in which no business is done upon the circuits at such offices. The E. M. F. of the dynamos has been decreased from 40 volts to 6 volts and each local electromagnet has a resistance of 10 ohms; the rest of the circuit in its normal condition includes 20 ohms inductanceless resistance making a total of 30 ohms.

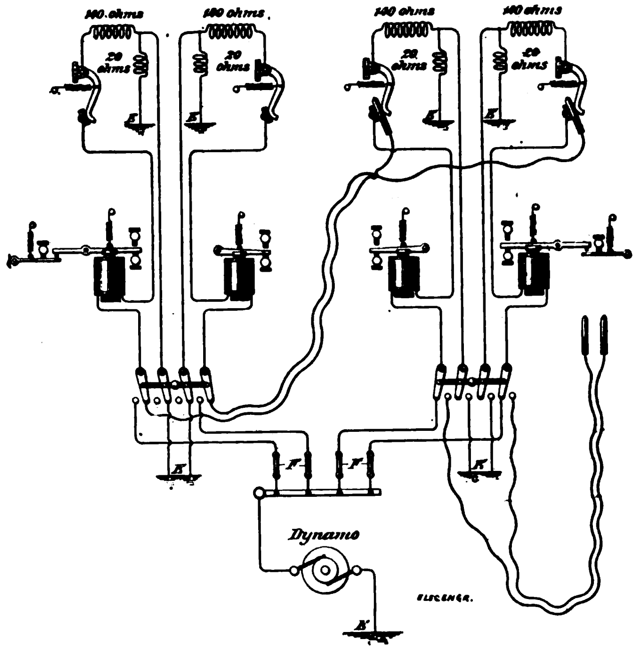


FIG. 3.

The 10 ohms resistance, inserted in the circuits between the dynamo and the fuses serves as a safeguard against a dangerous current in case of an accidental short-circuiting of the electromagnet and a failure of the fuses F^1 F^2 to act, and also to diminish the time constant of the electromagnets. By tracing the circuits it will be seen that the transmitter T and receiver R of the set on the left are locally connected through wedges w^3 and w^4 with the receiver R and transmitter T, respectively, of the set on the right. The switches are placed upon the tables near the repeaters so that if trouble occurs on either circuit the attending operator is able, by turning s^1, s^2, s^5 and s^6 to place the left-hand set independent of the right hand set, so that adjustments may be made without leaving the vicinity of the repeater apparatus, and similarly with the right-hand set by use of s^3, s^4, s^7 and s^8.

Fig. 3 is another method of accomplishing the purposes of Fig. 2 and will be understood by inspection.

GRAPHITE AND GRAPHITITE.[1]

GRAPHITE plays an important part in the manufacture of arc-light carbons, and has in the process to be first of all finely powdered. According to some researches of W. Luzi (*Deutsch. Chem. Gesellschaft*, Vol. XXIV) certain kinds of graphite, which he proposes to call *graphitite*, may be very easily reduced to powder by chemical means. It has been known for some time that graphite boiled in certain reagents, and then washed and dried, swelled in a most extraordinary fashion when baked. These reagents were concentrated sulphuric acid and a mixture of concentrated sulphuric and nitric acid. W. Luzi finds that fuming nitric acid is also a reagent. The graphite which exhibits this peculiarity of swelling comes from the following sources :—Ticonderoga, Pfafferreuth, Ceylon, Buckingham (Canada), Argenteuil (Canada), Massachusetts, Amity (N. Y.), Greenville (Ont.). The so-called graphitite comes from Passa (Siberia), New Mexico, Burkhardtswald (Saxony), Idar, Fichuelgebirge, Diedelkopf (Tyrol), Levigliani (Italy).

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[1] London *Electrician*.

METALLIC vs. MERCURY PUMPS FOR EXHAUSTING INCANDESCENT LAMPS.

BY

A L Reinmann

WHEN I began to make some of the well-known Geissler tubes some twenty-five years ago, and made use of the simplest kind of mercury pump, which is now described in various catalogues of dealers in chemical glassware, such as the Doepler pump, I found it difficult, with the aid of such a pump, to exhaust tubes sufficiently well to cause a one-inch spark from a Ruhmkorff coil to disappear entirely. Later on the Sprengel pump was used for the production of high vacua, and the Geissler pump was subsequently improved by H. Geissler himself, as well as by others in this country, among them being Mr. Edward Weston, and the writer, the latter having patented the stationary reservoirs, now used exclusively, together with the floating valves, and the system of operating a series of pumps from one controlling device.

While such improvements have made it comparatively easy to exhaust incandescent lamps, it would be unwise to close our eyes to further improvements and not to look for means by which various drawbacks of the mercury pumps can be avoided. In large factories, particularly where Sprengel pumps are used, it is almost impossible to prevent the spilling of the mercury, which is carried with the dust and inhaled by the attendants. In case of breakage of a Geissler pump, 30 to 40 lbs. of mercury often run over the floor, and, in spite of all precautions, some of this mercury is lost, while the rest has to be carefully cleaned. Another item worth considering is the cleaning of the mercury pumps. Strong acids, such as nitro-muriatic, and as a second wash sulphuric acid, have to be employed to dissolve the deposits made by the oxidation and the mixing of mercury with the grease used for lubricating stopcocks and glass joints, and the fumes thus produced are most decidedly injurious to health. At the same time such cleaning means a good deal of breakage and comparatively expensive repairs are required on account of the necessary skilled labor.

It is true that with a series of Geissler pumps, as improved of late—with automatic floating valves, stationary reservoir and the improved reverser, which either turns the main stopcock to the mechanical pump to lower the mercury from the exhaust chamber, or turns it to the open air to admit the atmospheric pressure to force the mercury into the exhausting chamber and there displace the air and gases drawn from the lamps into the upper line of iron pipes, which is also connected with a metallic pump, to relieve such movement of all back pressure—these, I say, can work without interruption, and certainly do the work admirably. But it requires the aid of large mechanical pumps to keep the mercury moving, pumps of such size as would be able to do the exhausting alone, if properly constructed; and as the material for mercury pumps is rather frail in comparison with metal, the mercury, acting as a piston, cannot move up and down fast and not move them faster than once a minute; otherwise the pumps would be in danger of being smashed. On account of so slow an action (in fact the lamps are not in communication with the exhaust chamber during the time the mercury rises), the electrical treatment of the carbons has to be carefully watched, so that they are not injured beyond repair, should the current act too soon or excessively upon them in the presence of gases and the trifling amount of air remaining in the bulbs.

Among the many reasons, the few I have mentioned have made it desirable to improve mechanical pumps so far as to make use of a direct exhaustion from this source, instead of using metallic pumps to operate a series of mercury pumps. I have had occasion to witness the working of the metallic pump constructed by Messrs. Dittmar and Falkenhausen, and called in the patent papers "Electric Air Pumps," presumably because the valves are operated by the aid of solenoids, and which was described in THE ELECTRICAL ENGINEER, of June 4.

Three hundred lamps exhausted per day on a cylinder 7 x 8 showed such a good vacuum, that the spark of a 1-inch Ruhmkorff coil could not be noticed, merely creating the appearance of minute flashes due to the phosphorescence and fluorescence of the glass. A lot of twenty-four of these lamps subjected to a test showed, after 350 hours, a drop of 1 c. p., and only the faintest sign of discoloration. With the aid of first-class material, and added experience in lamp making, the leaky lamps should be so few that even a large number of lamps can be exhausted at one time. But the mechanical pump I have mentioned can be built to such size, that even 100, or more, lamps connected on to one cylinder, can be exhausted very rapidly; and as the piston makes 30 strokes per minute, the occluded gases are removed so fast that the current to the lamps can be raised in shorter periods and the whole electrical treatment can be accomplished within 15 minutes, making it possible to get along with less apparatus, such as generators, and to lessen considerably the size of a pump-room.

While I have no actual figures on hand as yet regarding the cost of exhausting by means of mechanical pumps, I know that a lamp exhausted by the Geissler system costs more than 2½ cents on an average, including all expenses for help, power, material repair, rent and superintendence, and I have no doubt that this figure can be reduced by adopting the metallic pump in factories of large capacity and output.

INSULATED ELECTRIC CONDUCTORS.—VII.

BY

James Bowstead Williams

Balata.—This substance is obtained by evaporating the milky juice of the bullet tree which grows in Guiana and elsewhere. When pure it resembles gutta-percha; and like the latter contains a small quantity of resinous matter. While it is generally considered by manufacturers to be a superior kind of gutta-percha, yet it differs from this substance in some respects, and may be considered as occupying a position midway between gutta-percha and india-rubber. For general purposes of insulation it would appear to be superior to gutta for the reason that it is more elastic, does not become so rigid at low temperatures, and does not deteriorate so rapidly when exposed to the atmosphere. But time and experience are necessary to demonstrate this.

Balata can be used for the same purposes as gutta, and can be applied to electric conductors in the same manner. Like gutta, it should not be used to insulate aerial conductors unless it can be thoroughly protected from air and light; otherwise it also degenerates into a brittle resinous mass. It can be combined with gutta, or rubber, or their compounds, both for vulcanized or unvulcanized compositions, to form useful compounds. It can also be combined with other insulating material which is added, if added, to dilute the gum and to lessen the cost of the products. Balata is said to be extensively used in this country in the manufacture of chewing-gum.

Resins.—Resins are non-crystalline bodies insoluble in pure water, but mostly soluble in alcohol, essential oils, ether, hot fatty oils, and bisulphide of carbon. They combine with alkalies to form soaps, and become soft, and finally melt, when sufficiently heated. If ignited they burn with a bright smoky flame; and if the smoke be collected it will be found to contain a large quantity of soot.

Gum resins contain gummy or mucilaginous substances in combination with the true resinous principles. These gummy and mucilaginous matters possess very slight insulating properties, as a rule, and if they are removed from the gum resin the resin which is left will be found to have a much higher specific resistance than the original substance.

If we take most of the commercial resins and gum resins and extract the pure resins from them, we will find that there is but little difference in the specific resistance of these extracts. These true resins are very brittle, however, and are not at all suitable for insulation when used alone, but must be combined with other insulating material which will impart the requisite degree of flexibility to the combinations. For this reason gum resins are sometimes more suitable for certain kinds of insulating compounds—*e. g.*, paints—than the pure resins, on account of the greater flexibility and toughness of the former.

Oleoresins are resins combined with essential oils. They possess but little value, as such, for insulating purposes, and could be dispensed with altogether.

Of the resins now used in practice the most important are colophony, shellac, copal, and amber. If these are purified and properly used they are of the greatest value, when used in suitable combinations, for use in all kinds of insulating compositions.

Colophony, or rosin, is obtained by distilling the crude turpentine (oleoresin), which exudes from various species of the pine, in copper stills at 212° to 316° F. The products of the distillation are oil of turpentine, which passes off and the rosin which remains in the still and which constitutes from 70 to 90 per cent. of the original mass.

The appearance and physical properties of common rosin are too well known to require description.

The color of rosin depends upon the care taken to distil at a low temperature and upon the purity of the oleoresin. It varies from an opaque pitchy black, through various shades of red, brown and yellow, to an almost colorless transparent mass. These different colored rosins are designated by different letters of the alphabet, A being the darkest, W, the "window glass," and W W, the "white water" varieties. The darkest colored rosins are the best for insulating material, as they contain less volatile matters than the lighter grades. The transparent varieties are obtained by distilling the turpentine with steam, or other inert gas, at a pressure of about 150 pounds per square inch and at a temperature not exceeding about 600° F.

These rosins are principally used in the manufacture of soaps and transparent varnishes, and as adulterants for the costly copal and amber varnishes.

Ordinary rosin softens at about 170° F., and melts at about 212° F., although it gets sticky when held in the hand. If all of the volatile matters be removed from the rosin, its melting point is much higher than that above given, but the rosin also becomes more brittle when cold. But the melting point of each variety should be ascertained, and the material tested electrically and chemically before it is used for insulating purposes.

Rosin is one of the most valuable insulating materials known. When pure, its specific resistance is very high, and it is capable of entering into combinations with almost all other kinds of insulating materials, whether the combinations be used while in a melted state, or in solution, or in vulcanized compounds. In the latter class of compounds it should always be combined with paraffine, shellac, or other suitable material which does not attack rubber, when heated to a vulcanizing temperature, before it is incorporated with the rubber, sulphur, etc., by means of the mixing rolls. If this be not done the rosin will almost invariably attack the rubber. Rosin will dissolve rubber in about five hours at a temperature below the boiling point of the rosin, and cause the vulcanized compound to deteriorate when exposed to the atmosphere.

No fixed rules can be given as regards the combining power of rosin with other substances, such as paraffine, ozokerite, asphaltum, etc., when the mixtures are to be used while hot to saturate fibrous material which has been applied to electric wires. This can be ascertained only by experiment, for it will be found that different samples of the substances above named are apt to vary considerably from each other. Thus, one sample of paraffine may contain less paraffine oil than the other; one sample of ozokerite contain more bituminous matter than the other, and the samples of asphaltum may vary on account of the different quantities of petroleum they may contain.

Rosin cannot be used alone to insulate wires on account of its brittleness and tendency to crack even when used with fiber and the wires remain perfectly straight. When combined with rosin oil or certain vegetable oils good flexible mixtures are produced which are well adapted for saturating fiber. But it can be stated as a general fact that all combinations of rosin and oil which possess good insulating properties absorb moisture when exposed, and that such combinations, to be of use, must be thoroughly protected from the atmosphere.

The melting point of rosin and of other resins can be raised by the addition thereto of lime or other alkali while the rosin is liquefied by heat. But no advantage is gained by this procedure, for the brittleness of the rosin is likewise increased and moisture is more readily absorbed.

Rosin is the only flux which should be used when soldering electrical connections. Mixtures containing chloride of zinc never dry of themselves, and corrode the surfaces of metals upon which they are applied. But such mixtures can be used without injury to joints, if the entire surface wetted with the solutions be covered by the solder and the joints immediately protected with a covering impervious to air.

The solvents of rosin will be given in the chapter on Insulating Paints.

THE NEW POSTAL-TELEGRAPH BUILDING.

So great has been the increase in the volume of business handled by the Postal Telegraph-Cable Company, that the necessity for more commodious and convenient quarters for the executive and operating departments has become imperative, and the officials of the company have for some time past been engaged in arranging to secure the company a building of its own. The corner of Broadway and Murray streets was selected as the best site for the purpose, it being in the centre of down-town business interests, near the newspaper offices, and convenient of access by all lines of elevated railroads, horse cars, ferries and the Brooklyn Bridge, while the frontages on City Hall Park and Murray street insure ample light and air.

Immediately upon the selection of the location, negotiations for the purchase of the necessary ground were completed, and plans for the new building prepared. Already the old buildings have been torn down and work on the foundations for the new structure is well under way and progressing rapidly.

The accompanying illustration is from the architect's drawing, and shows the building as it will be when finished. The building will be 14 stories high and will have a frontage of about 75 feet on Broadway by 150 feet on Murray street, with an L of 30 by 50 feet at the rear end. The frame will be of steel, and the walls to the fifth story will be of a fine quality of Indiana limestone; the upper stories of gray brick, with terra cotta trimmings to correspond. The interior finish will be in keeping with the handsome exterior, and no efforts are being spared to make all of the fittings and arrangements of the latest and most approved modern design.

The sub-basement will be 12 feet deep, commodious, well lighted and artificially ventilated. Here will be located the engine and dynamo rooms; the boiler-room will be in the extension of the sub-basement and will be 14 feet deep. The heating apparatus and the two dynamo plants for lighting the building and furnishing current for the circuits will be of the latest approved designs and arranged with regard to convenience and the comfort of the men in charge. The basement will be used for the supply department of the company and for storage-rooms, and will be equipped with every facility for packing and handling material. It is also intended to utilize a portion of the basement for safe deposit vaults.

The first or ground floor will be used for the receiving and delivery departments of the company, and possibly a portion of it may be leased for business purposes. The second floor will probably be occupied by a bank; and other floors, to and including the tenth, will be rented for offices. Applications for a large number of these offices have already been received.

The New Postal-Telegraph Building.

The eleventh floor will be retained by the company for its executive offices and for the executive offices of the Commercial Cable Company, which is allied to the Postal Company.

The general operating department will occupy the entire eleventh floor. And here again the arrangements will be made with a view to attaining the greatest facilities for handling the business and to provide for the comfort of the employees. The ceiling will be 18 feet high, and the exposure on the east, south, west and part of the north sides will insure perfect light and ventilation. The apparatus will be new and specially designed for this office, and it is expected that the operating department will be a model in every respect. The thirteenth floor will be used to accommodate the clerical electrical force, and also for coat rooms, lavatories, etc., for the operating and electrical departments.

It is expected that the fourteenth story will be occupied by a business men's club, and restaurant for employees, but, as these arrangements have not been concluded, we are unable to give details.

As a whole the building will be one of the best examples of modern architecture in the city and in convenience of arrangement, excellence of construction and beauty of appearance will be second to none.

The drawing of the plans and the work of construction and arrangement are under the supervision of Mr. A. B. Chandler, the president of the Postal Company, to whom, in great measure, credit is due not only for the completeness of the new buildings, but for the success of the company which has made the erection of the building possible. Mr. Chandler is assisted in the direction of the new work by a building committee, consisting of Mr. W. H. Baker, vice-president, Mr. E. C. Platt, treasurer of the Postal Company, and Mr. Geo. G. Ward, vice-president and general manager of the Commercial Cable Company. Messrs. George Edward Harding and Gooch are the architects and have charge of the details of plans and construction.

It is expected that the new quarters will be ready for occupancy in the summer of 1893, and the company's employees are to be congratulated on their prospects for improving their present fine service with the aid of the most perfect appliances and in the most comfortable and convenient quarters which could well be provided for the purpose.

CHANGES IN THE CANADIAN PATENT LAW.

Important amendments have been lately made to the patent act of Canada by the Canadian Parliament. Some new features borrowed from the United States patent laws are noticeable, such as the employment of examiners in the Patent Office to make a thorough examination of the applicant's title to his invention. The other material changes made are noted below.

Models of inventions or specimens of compositions need now only be furnished if required by the Commissioner of Patents. The duration of a patent is to be 18 years, with a fee of $60, with the option, however, of paying partial fees of $20 and $40 for terms of 6 or 12 years.

The inventor's oath or affirmation may be made before a minister plenipotentiary, *chargé d'affaires*, vice-consul or consular agent, a judge of any court, a notary public, a justice of the peace, or the mayor of any city, borough or town, or a commissioner for taking affidavits having authority or jurisdiction within the place where the oath may be administered.

Importation of the invention into Canada after 12 months from the time of granting a patent (or any extension of such period) by the patentee, his representatives or assignees for a whole or a part of his interest in the patent, renders the patent void only as to the interest of the party importing or causing to be imported.

A federal court, the Exchequer Court, is given jurisdiction not only of all questions involving the validity of a patent but also of all questions arising as to whether any interest therein is null and void.

A citizen of Canada electing to obtain a foreign patent for an invention, before obtaining a Canadian patent, shall have the right to obtain a patent in Canada, if the same be applied for within one year of the date of issue of the first foreign patent, and if, within three months after the date of the foreign patent, the inventor gives notice to the commissioner of his intention to apply for a patent in Canada, then no other person having commenced to manufacture the device in Canada during such period of one year shall be entitled to continue such manufacture after the inventor has obtained a patent in Canada, without the consent of the inventor.

Mr. Alexander L. Lineff, whose system of conduit railway traction will be recalled by our readers, has arrived in this country. It is Mr. Lineff's intention to introduce his system in the United States, where, he is confident, it will find a ready acceptance when once its advantages are understood.

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VOL. XIV. NEW YORK, AUGUST 17, 1892. No. 224.

What is there so useful as a new idea so stated that it can be employed and lead to a useful practical result.—J. J. Storrow.

THE PROBLEMS OF COMMERCIAL ELECTROLYSIS.

ALTHOUGH one of the earliest principles of electric action applied to commercial purposes, electrolysis has, until a comparatively recent period, been confined to but a few fields of usefulness, and, with one or two exceptions, even these have been very limited in actual commercial product turned out. That there has been no lack of experimental investigations in this domain will become apparent upon even a cursory examination of the literature on the subject, which dates back over a hundred years. Of late, however, renewed interest is being manifested in electrolytic work, and in a variety of branches. Some of these have already been cultivated to some extent, and others involve original processes. In a review of the problems of commercial electrolysis, submitted in a paper read before the London Institution of Electrical Engineers, Mr. James Swinburne has outlined briefly the salient features of the most prominent electrolytic applications of the day, both actual and proposed, and has made some suggestive remarks touching their probable future. Passing over the methods whose success is already well established Mr. Swinburne, taking a broad view, asks: "Which of the oxidizing and reducing processes in use in chemical works can we advantageously replace by electrical methods?" He answers this question by stating, that "in many cases electrical methods are impossible; in others they are more expensive than those at present in use; but it is hardly too much to say that in an enormous number electrolysis is destined to play a leading part in the near future." Among the products included in the latter class, Mr. Swinburne mentions oxygen, which, he calculates, can be produced for less than one-tenth the selling price of the chemically prepared gas. In the production of caustic soda and its accompanying by-product, bleaching powder, Mr. Swinburne figures a large margin of profit by the use of the electric current; but he draws attention to the difficulty thus far invariably encountered in the gradual destruction of the positive electrodes, even carbon succumbing to the corroding action of the current, while platinum, though not entirely free from attack by chlorine, is too expensive. Mr. Swinburne also draws attention to the fact that much has still to be done in the production of aluminum, magnesium and the refining of the precious metals directly from the ores; the recovery of tin from scrap iron, the production of ozone, electric tanning, etc. The field here open to practical commercial results is indeed without limit. The refining of copper alone is well worthy all the effort and time that can be bestowed upon it, but by no means represents all that holds out promise of success. It may be well, however, to point out to beginners in electrolytic work that pitfalls may await them and that a thorough study of the literature of the subject may forestall discouraging experiences.

MECHANICAL VACUUM PUMPS FOR EXHAUSTING INCANDESCENT LAMPS.

THE tests on incandescent lamps recently conducted by Prof. B. F. Thomas and his associates and embodied in a paper read before the American Institute of Electrical Engineers, have elicited an interesting discussion in our columns between lamp makers as to the relative advantages of the mechanical vacuum pump as compared with the mercury pump now in general use. Leaving aside the question of the immunity from blackening claimed for lamps exhausted mechanically, which claim Prof. Thomas's tests seem to confirm, another question has arisen as to the economy of the mechanical method of exhaustion as compared with the mercury pump. Among those who have had opportunities for observation on the subject probably second to none is Mr. A. L. Reinman, whose views are given in a communication printed elsewhere in this issue. After years of work with the mercury pump, Mr. Reinman inclines to the opinion that the mechanical vacuum pump is capable not only of effecting an exhaustion equal to that of the mercury pump, but that it can do so at a greater economy in cost, and that further experience with the mechanical pump will serve to demonstrate its superiority.

HIGH VOLTAGE INCANDESCENT LAMPS.

THE description of high voltage incandescent lamps, which appeared in our columns recently, has served to bring out an interesting communication on this subject from Capt. A. de Khotinsky, which will be found on another page. It is well to emphasize the fact pointed out that lamps of higher voltage than those now customarily employed in incandescent lighting have been in commercial use for some time past, and that they can be successfully manufactured. It will also be remarked, however, that their cost is somewhat higher than that of the ordinary 50 or 100 volt lamps. It would be interesting to know just how far the increased cost of the lamp would outweigh the economy in distribution effected by the reduction of copper brought about by the employment of the higher potential lamp.

MEETING OF THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES AT TORONTO.

The Eighth Annual Meeting (13th Convention) of the Association of Edison Illuminating Companies met in Toronto at the Rossin House, on Tuesday, August 9.

The following members were present:

W. M. Brock, general manager Edison Electric Illuminating Co., Paterson, N. J.

A. F. Walker, superintendent Grand Rapids Edison Light and Fuel Gas Co., Grand Rapids, Mich.

W. S. Barstow, general superintendent Edison Electric Illuminating Co., Brooklyn, N. Y.

Wilson S. Howell, treasurer of the Association, and honorary member.

Frederick Nicholls, president Toronto Incandescent Electric Light Co., Toronto, Canada.

C. L. Edgar, general manager Edison Electric Illuminating Co., of Boston.

J. H. Vail, assistant engineer-in-chief General Electric Co., New York.

J. A. Colby, secretary and manager Edison Light Co., Des Moines, Iowa.

F. E. Jackson, Edison Lamp Works, Harrison, N. J.

W. L. Garrison, treasurer Edison Electric Illuminating Co., Brockton, Mass.

Geo. R. Stetson, president New Bedford Gas and Edison Light Co., New Bedford, Mass.

Charles R. Price, treasurer New Bedford Gas and Edison Light Co., New Bedford, Mass.

William D. Marks, president Edison Electric Illuminating Co., Philadelphia, Pa.

J. H. McClement, president Edison Electric Light and Power Co., Amsterdam, N. Y.; also of Winston-Salem Railway and Electric Co., Winston-Salem, Va.

Arthur Williams, general inspector Edison Electric Illuminating Co., New York City.

Arthur E. Kennelly, Edison Laboratory, Orange, N. J.

A. L. Smith, president Appleton Edison Electric Co., Appleton, Wis.

Charles Wustenfeld, manager Elgin City Railway Co., Elgin, Ill.

Hoyt Post, director and attorney Edison Electric Illuminating Co., Detroit, Mich.

C. P. Gilbert, secretary and manager Edison Electric Illuminating Co., Detroit, Mich.

E. R. Weeks, general manager Edison Electric Light and Power Co., Kansas City, Mo.

S. B. Eaton, general counsel Edison Electric Light Co., New York City.

G. H. Van Etten, Edison Electric Light and Power Co., Little Rock, Ark.

J. E. Sayles, general agent Edison Electric Illuminating Co., of New York.

Charles H. Lindenberg, Columbus Edison Electric Light Co., Columbus, Ohio.

A. W. Field, secretary and manager Columbus Edison Electric Light Co., Columbus, Ohio.

Samuel Insull, president Chicago Edison Co., Chicago, Ill.

W. J. Jenks, Edison Electric Light Co., New York City.

George H. Finn, secretary, treasurer and manager St. Paul Edison Co., St. Paul, Minn.

Maurice Hoopes, superintendent Edison Electric Illuminating Co., West Chester, Pa.

W. E. Rundle, official stenographer.

John I. Beggs, director Harrisburg Electric Co., Harrisburg, Pa.

J. H. Sheddy, general manager Renovo Edison Light, Heat and Power Co., Renovo, Pa.

A. D. Page, assistant manager Edison General Electric Co. Lamp Works, Harrison, N. J.

John R. Markle, director Edison Light Co., Grand Rapids, Mich.

John Langton, Canadian Works Edison General Electric Co.

Henry W. Darling, vice-president Newport Illuminating Co., Newport, R. I.

H. J. Smith, general operating superintendent Edison Electric Illuminating Co., of New York.

M. D. Barr, district manager Edison General Electric Co., of Toronto, Ont.

Edwin W. Hammer, Edison Electric Light Co., New York City.

C. R. Van Trump, engineer and manager Wilmington City Electric Co., Wilmington, Del.

W. S. Andrews, general superintendent Canadian Works Edison General Electric Co.

FIRST SESSION.

The first session was called to order at 2.30 p. m. by Mr. John I. Beggs, who has been for the past six years president of the Association.

The standing committees of the Association were called upon for reports, and from these reports several discussions of practical subjects resulted. These included the importance of high insulation in the interior wiring of buildings and the improvement of safety fuses. On several of these questions the Association was favored with a practical talk by Capt. William Brophy, who, by vote of the meeting, was specially invited to be present and participate in the discussion.

Mr. J. H. McClement raised some interesting questions relative to the possibilities of operating electric railway systems, and during the discussion, Mr. William Lloyd Garrison, of Boston, was called upon and gave in an exceedingly interesting manner some results of his pioneer incandescent electric light experience at Brockton, Mass. Instructive remarks were made by Messrs. Barstow, of Brooklyn, and Mr. Stetson, of New Bedford. By invitation of the Association Mr. M. J. Sullivan, for several years official stenographer of the Association, read a paper entitled "The Central Station and Street Railways," which commanded the close attention of the delegates and occasioned further discussion on the questions suggested.

An interesting and valuable paper, illustrated by statistical tables and diagrams, was read by Mr. J. H. Vail on "The Application of New Apparatus and High Economy Engines in Central Stations to secure Greater Commercial Efficiency and Economy of Coal."

On Tuesday evening the delegates were treated to a very pleasant sail on Lake Ontario by the Toronto Incandescent Electric Light Co., of which Mr. Frederick Nicholls is president, and who had neglected nothing that might in any way add to the comfort or pleasure of their guests. Carriages were furnished to and from the wharf, and music and refreshments were provided on the boat for the entertainment of those present. The excursion was thoroughly enjoyed by all, the cool lake breezes being very refreshing after the heat of the day and the long afternoon session.

SECOND SESSION.

Returning from a delightful drive through the suburbs of the city, in open carriages provided by the Edison Company of Toronto, the Association convened at eleven o'clock a. m., August 10.

The courtesy of the Edison Company in arranging for this early morning drive and the moonlight sail of the previous evening was suitably acknowledged by vote of the Association.

The Canadian Department of the General Electric Company offered to the delegates an excursion to the Peterborough factories, but as the business engagements of the majority of the members of the Association prevented any general attendance upon such an excursion, the invitation had to be declined. The principal feature of the day's programme was a discussion of important questions of business policy.

In the afternoon the discussions of the morning were continued; Mr. C. A. Coffin, president of the General Electric Company, and Major S. B. Eaton, general counsel of the Edison Company, being present and participating.

The following officers were chosen for the year to come: President, John I. Beggs; vice-president, Frederick Nicholls; secretary, W. J. Jenks; treasurer, Wilson S. Howell. Executive committee, C. P. Gilbert, C. L. Edgar, E. R. Weeks, W. D. Marks, Samuel Insull. The question of the place of holding the next annual meeting was left to be decided by the executive committee.

A statement regarding the work which had been done during the year by the fuel gas committee was made by J. R. Markle. The committee was continued for another year, as were also the committees on lightning protection, dangers from systems of high pressure and grounding the neutral wire.

Besides the delegates in attendance there were quite a large number of visitors and representatives of supply houses, several of whom made exhibits of their apparatus.

STORAGE BATTERIES IN THE COOPERSTOWN, N. Y., CENTRAL STATION.

In reply to an inquiry as to the employment of storage batteries in the station of the Cooperstown, N. Y., Illuminating Co., we have received the following information from the superintendent, Mr. John F. Corbin: We have in use from midnight until morning 56 cells of The Accumulator Co's. type "A" battery, which will stand a discharge of 35 amperes. As we maintain 110 volts upon our circuits and each lamp requires ½ ampere we can feed 70 night lamps if occasion requires. Our ammeters indicate 22 amperes (44 lamps) in use when we bank fire and stop engine and dynamos at midnight. At daylight we find a draught of 10 amperes upon the battery; at 6 a. m., 6 to 8 amperes; at 7 a. m., 3½ to 5 amperes. We charge the battery from four to five hours with 25 amperes. From Nov. 1 to April 1 we relieve the battery at 5 a. m., and run the engine and dynamos until after sunrise. This is necessary because the morning lighting requires more than 35 amperes.

RATIONAL AND EMPIRICAL FORMULÆ SHOWING THE RELATION BETWEEN THE MAGNETO-MOTIVE FORCE (*H*) AND THE RESULTING MAGNETIZATION (*B*)[1].

BY CHARLES E. EMERY, PH. D.

THIS paper is in three parts, with sections numbered consecutively. It will not be possible to preserve the section numbers in this abstract, but the references thereto, in the original, remain in many cases. The author states that in Part I the theory that magnetization is the circulation of an ether is examined by the law of the flow of fluids, with the gratifying result that a rational fluid function has been developed which corresponds very well with the observed curves of magnetization, and which, moreover, shows decidedly a phenomenon equivalent to that of magnetic saturation. The observed results indicate a more intense action during the earlier stages of magnetization than is provided by the fluid function, but the discussion shows that the theory of molecular magnets appears quite sufficient to account for such intensified action. Following the discussion on this subject there are presented in Part II, Sec. 23, empirical formulæ for practical use, corresponding satisfactorily with typical *H-B* curves derived from experiments,[2] and in the "*Conclusion*," Sec. 36, a general formula is derived, embodying the fluid function first discussed, and a linear function, which together satisfactorily represent, on a rational basis, the observed conditions throughout the entire range of observation, including Ewing's experiments with very high magnetizations.

The human mind must found its impressions of unseen phenomena on analogy, so it is natural to suppose that all "action at a distance" is due to the motion of something extending through that distance. The rational discussion is based on a theory which has heretofore been proposed in substance, though generally with hesitation, shown by the fact that other plausible theories were advanced in the same connection. It will be considered that the magnetic field results from the circulation along definite lines of an ethereal atmosphere of such extreme tenuity that it moves readily through all bodies, fluid or solid, of which our senses are cognizant, though, like other fluids, capable of being moved and directed by other forces and of being concentrated in certain paths by particular materials. If this theory be true the etheric fluid should respond to the same laws as govern the flow of other fluids, air and water for instance, and we will first examine the formulæ relating to fluids tangible directly to our senses, and see if the flow of a fluid of such extreme tenuity that we cannot feel, see or hear it, but only judge of its presence and its circulation by the results produced, will show in such formula a substantial agreement with the observed results. Starting with well-known formulæ derived from the law of falling bodies, the author first develops the equation of the flow of an incompressible fluid and states that it indicates the general form of a differential equation of the flow of an elastic fluid which will show the momentary rate of flow of its elementary masses. With an elastic fluid the density practically varies with the pressure. If p be the total pressure, a certain portion, rp, is required to overcome resistances, and the remaining portion, $(1-r)p$, is the part available for density. By combining these quantities in a differential equation, integrating and substituting in quantities referring to etheric magnetic flow, the author deduces

$$I = A\,(3r^2-2r^3)^{\frac{1}{2}}\,(fH)\,H_s \qquad (10)$$

in which H is the exciting force, H_s the exciting force at saturation, r the proportion of the exciting force required to overcome resistances, A the product of the several constants developed, and I the portion of the magnetization due to what the author calls "the concentrating influence of the iron," and which according to the experiments of Ewing is to be added to lines proportioned to the exciting force H, which the author described as "lines which flow through the space occupied by the iron as though no iron were present." The total magnetization, B, is then equal to $H + I$. In Eq. 10, the function $(3\,r^2 - 2\,r^3)^{\frac{1}{2}}$ develops a factor of the variable coefficient of H_s, depending upon the law of the flow of fluids, and all influences on the value of I, due to external causes, are provided for by the other factor, $A\,(f\,H)$. In the above expression if $r = 0$, so that no part of the pressure is expended to produce motion, the whole equation reduces to 0 and there is no flow. If $r = 1$ the expression containing r reduces to unity. The ordinates of the fluid function are shown proportionally in Fig. 1. A direct linear function is shown by the diagonal. The modification due to $3\,r^2 - 2\,r^3$ is represented by the reversed curve in dotted lines crossing the diagonal at the centre of the figure, and the complete function including the square root of the above is shown by the heavy line curve. The latter is in general similar to a curve showing the relation of the exciting force H to Ewing's intensity of magnetization I, and also resembles an *H-B* curve of magnetization, with a less intense initial action which is yet to be provided for by substituting in Eq. (10a.) the value of $(f\,H)$. If we adopt the theory of etheric flow, we must conceive that the magnetization expressed at present as a definite number of magnetic lines is represented by the flow of a definite weight of etheric fluid. Recalling the signification of r and $1 - r$, it will be seen that the fluid function simply shows that when r is small, but little of the exciting force is expended in forcing forward the electric fluid and the larger portion of such force is utilized in increasing the density of the etheric fluid circulated, so that the weight circulated, and therefore utilized, is large compared to the exciting force expended to produce circulation, a higher percentage of the total exciting force is utilized and a higher efficiency of transmission obtained. When, however, the flow in a given area is increased, a larger proportion of the exciting force is required to produce the circulation, and a smaller quantity available to increase the density; so the weight moved approaches a limiting or constant value which evidently will be reached when the volume is infinite and the density zero, a condition typified when $r = 1$ in Eq. (10) and Fig. 1, and by the magnetic condition that the permeability μ and induction I, due to the iron, each reach a maximum. *The author therefore calls especial attention to the fact that the simple laws relating to the flow of tangible fluids show a limiting condition analogous to that of magnetic saturation.*

The author then discusses at considerable length Weber's theory of molecular magnets as amplified by Maxwell and Ewing, submitting in connection therewith a sheet of curves showing Kirkaldy's experiments on the compression of steel, such curves bearing a remarkable resemblance to *H-B* curves of magnetization, and concludes that this theory "offers an interesting and somewhat plausible explanation of the whole phenomena without necessarily involving the theory of etheric flow. The author, however, contends that *etheric motion of some kind necessarily follows from the phenomena of magnetic action at a distance* (Sec. 2); that magnetic phenomena rather indicate a flow than a transfer of vibrations; that the fluid function plotted in a curve shows a general similarity to an *H-B* curve and a limiting condition analogous to magnetic saturation (Sec. 9); that such fluid function therefore confirms the theory of translatory rather than vibratory movements of the ether to explain magnetic phenomena, and that, therefore, such function is of the highest importance as evidence to connect magnetism with ethereal flow On the contrary, the theory of molecular magnets does not aid in the explanation of action at a distance, but is still of value to intensify the effects shown by the fluid function."

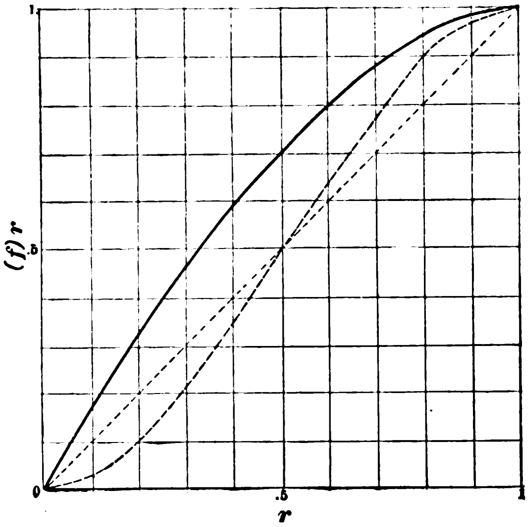

FIG. 1.

The author finally deduces a rational equation, embodying the fluid function, on the basis that the results shown thereby are intensified by the action of the molecular magnets. In such equation the influence which causes the initial delayed action of the iron, shown by the reversed curve at the origin of an *H-B* curve, is measured by the number of lines necessary to expand the core, disengage the molecular magnets from their accidental positions and arrange them substantially parallel. This number of lines is represented by k, and it is explained that $H-k$ is to be used instead of H in the final equation, thus practically causing the curve to intersect the axis of abscissa at a distance k from the origin. The value of r is stated as equal to the actual number of lines available for excitation, viz.: $H - k$, divided by the exciting force at saturation, viz., H_s.

In the form given above the fluid function is, as stated in Section 11, of insufficient intensity. If we consider, as is probable, that the molecular magnets act to change the intensity in accordance with the same laws as the fluid function acts, we can change the intensity shown by the fluid function by simply changing its exponent. As r is fractional, the intensity will be increased by *decreasing* the exponent. On this basis the following general equation is developed for $H = 0$ to H_s,

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[1] Abstract of a paper read at the general meeting of the American Institute of Electrical Engineers, Chicago, Ill., June 6, 1892.

[2] We expect to present the substance of Part II in a subsequent article.—EDS.

$$B = (H - k) + K\left(3\left(\frac{H-k}{H_s}\right)^2 - 2\left(\frac{H-k}{H_s}\right)^3\right)^n \qquad (26)$$

For H greater than H_s.

$$B = (H - k) + K.$$

That is, above the point of saturation the iron ceases to act to concentrate magnetic lines, so the fluid function must be caused to disappear as r reaches its limiting value, unity.

In connection with the proposed change of the exponent, the author calls attention to the curious fact that with $n = 1$ the equation is that of a straight line and plots in the diagonal of Fig. 1, while if $n = 0$, or rather when it has a very small finite value, the curve develops a right angle, so that "for values of n intermediate between 0 and 1 the whole area of the triangle would be filled with similar curves, gradually changing in shape from a right angle to the hypothenuse of a right angled triangle." It is stated that, therefore, by changing the exponent, the bend in the curve may be made as sharp as desirable. The curve shown in Fig. 3 was developed by making $k = 2.3$, $H_s = 500$, $K = 21{,}800$, and $n = 0.08$. Such curve corresponds closely to other curves within the limits usually stated. The author discusses the experiments of Ewing at some length, and in connecting Ewing's work with high magnetizations with that done by others within customary limits, concludes that, at the higher limits, the magnetization increases directly with the exciting force and is numerically equal to the saturation value of I, plus the exciting force H, and indicates that this law extends from these high values back to the origin where the exciting force and magnetizations are zero. If in Fig. 2 we let the ordinates of the triangle R T S represent the lines of magnetization due to the solenoid, or substantially in the language used in Section 17, to the number of lines circulated through the space occupied by the iron as if no iron were present, the base and altitude of this triangle will each equal H, and on the principle above stated, this triangle must be superimposed upon a rectangle of which the base $= H$ and the altitude equals the saturation limit of the iron or I maximum which we will call K. The figure has purposely been drawn to scale to include the highest values given by Ewing (Table 3), viz.: for $H = 19880$, $B = 41140$.

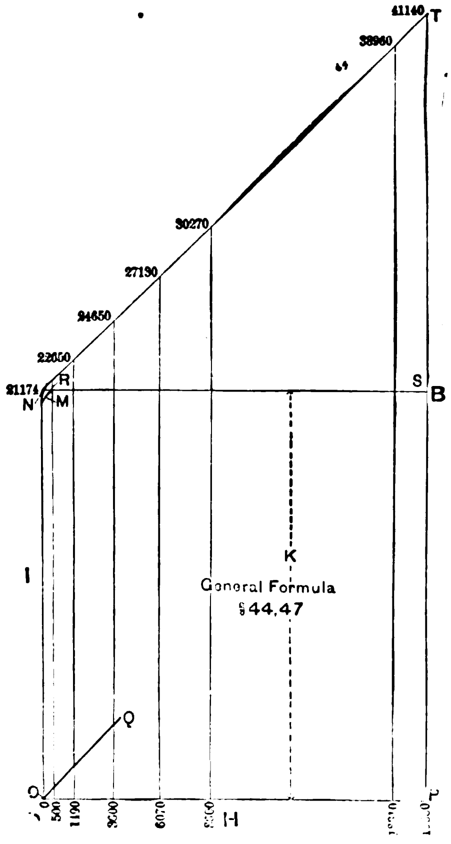

FIG. 2.

Further investigations appear to show that the iron which produces a concentration, $K = 21174$ lines per square centimetre reaches saturation with an exciting force H_s between 500 and 2,000 lines, whereas less than 100 lines are generally used, so the only part of the trapezoidal Fig. 2 which we refer to in practice is about $\frac{1}{100}$ of its length, or about $\frac{1}{5}$ of the portion included between the ordinates at the origin and the parallel line close thereto marked 500. In order to ascertain how the ordinary H-B curve of magnetization applies within this limit, it is necessary to make another view, Fig. 3, extending from $H = 0$ to 500, the range included between the first two ordinates in Fig. 2, but with the horizontal scale magnified. In this view $R\ T^1\ S^1$ represents the initial portions of the triangle $R\ S\ T$ in Fig. 2, and $O\ R\ S^1\ P^1$ represents similarly a portion of the rectangle below the same. M represents a modified curve of magnetization in which the ordinates of an ordinary H-B curve are shortened by the corresponding values of H when measured from the base $O\ P^1$, and N represents the same curve of reduced height when the ordinates are measured from an inclined line $O\ Q^1$ parallel to $R\ T_1^1$. The curved gore between M and N has the same area as the portion of the triangle from the ordinate at the origin to the point of tangency of the curve, so the upper curve N represents the entire H-B curve of magnetization if its ordinates be measured from the base $O\ P^1$.

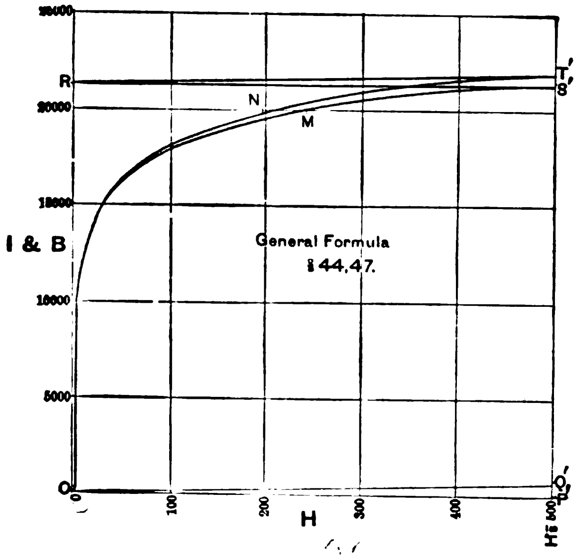

FIG. 3.

In closing this branch of the subject, the author considers how other physical phenomena can be explained if it be finally settled that magnetism is due to the circulation of an ethereal atmosphere. In such case we must imagine that the ether pervades all space, and we may suppose it susceptible to vibrations, and therefore capable of transmitting vibratory forms of force, such as light, without interference with the phenomena of magnetism due to the circulation of its ultimate particles. This atmosphere need not necessarily be the luminiferous ether, though there is no reason why it should not be so. The etheric fluid itself may pass freely through all substances, gaseous, liquid or solid, and yet its vibration known as light be damped and checked by some of such liquids and solids, but flow freely in others known as transparent. It will be more difficult to consider one mode of motion of the same ether as light and another as electricity, for both modes of motion should be damped by the same substances that dampen light, whereas we know that light is readily transmitted through glass and electricity is not, and that electricity is readily transmitted through copper and a similar class of substances known as conductors, which do not transmit light. If magnetism be the circulation, and electricity a form of vibration, of the same ether, there would be a more direct transformation of electric into magnetic force, whereas we know that no direct transfer takes place. A magnetic flow and an electric current may be moving at the same time in the same piece of metal, an iron magnet for instance, without one modifying the other in any way.

Any explanation founded on the anology of the polarization of light should be proved from some direct transformations of electricity into light without heat. Tesla appears to be doing this, but it is believed that his results can be explained on the basis that the passage of a high potential and high frequency alternating current through a low conducting medium actually puts the ether in vibration, thus producing light as above indicated. It is

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1. This is the I-B curve of Ewing.

believed also that the apparent transmission of high tension discharges through the dielectric instead of the conductor will eventually be traced to a magnetic phenomenon, leaving us free to consider substantially as in the past that electrical phenomena are due to a form of motion of the molecules of solids which are susceptible to this kind of motion, like metals of the copper class, though the molecules of all substances, even of gases, and possibly of ether, are conductors in a limited sense or under peculiar circumstances.

THE ELECTRIC PERCUSSION DRILL IN THEORY AND PRACTICE.[1]

BY HARRY N. MARVIN.

THE general requirements of an electric percussion drill for mining work are that it shall be light enough to be quickly handled by two or three men; powerful enough to compete with an air drill that absorbs eight or ten horse power; so simple in its design that it can readily be repaired by an ordinary mechanic without electrical experience; so constructed that the complete machine and its several parts can be soaked in mud and water without injury; be incapable of burning out; able to endure the roughest handling without injury, and the materials employed should be as little subject to crystallization as possible. My experience suggests the following elements of construction to be avoided: Traveling conductors; commutating or current shifting devices; sliding contacts; spring contacts; cotton insulated wire, and all insulating material capable of carbonization; switches; lamination of the moving parts; close fittings and joints liable to be impaired by considerable wear, and all constructions that may be injured by careless or unskilled attention. For the benefit of those unfamiliar with the actions of the air drill I will state that the general practice at present is to give the machine a stroke of from five to seven inches, to strike as nearly as possible an uncushioned blow upon the rock, and to make as many blows per minute as the power applied will develop, usually from two to four hundred per minute. It is found that a stroke of about five inches is necessary to properly free the hole from mud.

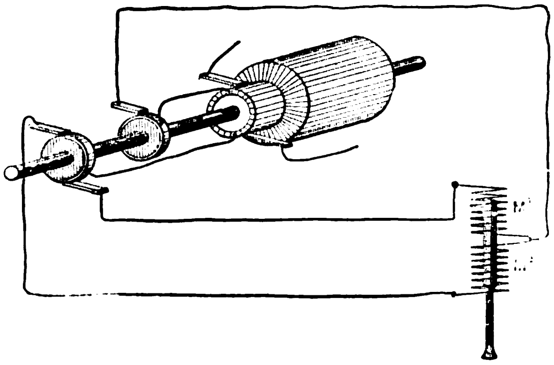

FIG. 1.

In the electrical solution of the problem the solenoid and plunger afford the simplest method of developing this action, and most of the work in this field has been confined to this line. After much experimental work with divided solenoids and commutating devices mounted upon the drill I abandoned these methods and in 1888 devised the system of operation that is at present rather well known, but for clearness may be illustrated.

Fig. 1 shows an ordinary continuous dynamo having two opposite points of its armature connected to a solid collecting ring and a half ring, respectively. The outer terminals of the drill coils M^1 and M^2 are connected by line wires to the two brushes alternately bearing upon the half ring. The inner terminals of the coil are joined and led to the solid ring. It appears that as the armature revolves current impulses are directed into the drill coils in alternation, causing a reciprocation of the plunger in synchronism with the dynamo armature. It will be noticed that the action here closely resembles the action of a steam engine, force being exerted first in one direction and then in the other, one end of the cylinder being idle while the other end is active. Of course connections are such that the polarity of the plunger is never reversed. This system simplifies to the utmost the construction of the drill and enables it to be so designed as to satisfy all of the conditions before mentioned. The complications of this system are more apparent in theory than in practice. Three wires are required, but once placed they give no further trouble. The generator can be used to develop continuous current and pulsating currents at the same time if desired, but I believe that it is better practice to use a separately excited drill generator without regular commutator. I have found it desirable to run these drills at a speed of about 400 per minute, a rather slow speed for small dynamos. By one method the regulator commutator of a continuous current armature is equipped with a pair of revolving brushes one of which connects to the solid ring of the drill circuit commutator and the other to the half ring. In this manner pulsations are developed in the drill circuit as the brushes are rotated and with a frequency entirely independent of the armature speed. With this arrangement we are also able to take off 100-volt alternating currents from a commutator that is also supplying a 500-volt continuous current circuit, by spacing the revolving brushes an amount less than 180°.

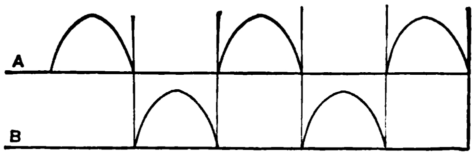

FIG. 2.

Another method of reducing the frequency of the pulsations is by gearing the drill commutator to the dynamo shaft, reducing the frequency to one-half the speed of the generator.

The general character of the impressed E. M. F. in the two drill circuits in the above systems is shown in Fig. 2, curve A showing the voltage over the upper coil and curve B showing the voltage over the lower coil.

A method of operation by which a somewhat different curve is obtained is shown in Fig. 3. It will be noticed that here current is admitted to the drill circuits when the voltage is at a maximum, the curve of impressed E. M. F. being generally as shown. The general plan of admitting the current alternately to the two drill circuits, one circuit being idle while the other is active, characterize all the above methods. This may be called plan "A."

I have also devised a method for effecting this without commutation, by leading one wire from a simple alternator to the drill while the other wire passes through the secondaries of two converters. The cores of these converters are continuously saturated by continuous currents in the primary coils, the windings of the converters being opposite. When current endeavors to pass through these it is checked considerably in the converter whose magnetism it tends to reduce and to a much less degree by the converter whose magnetism it tends to increase. A reverse current is opposed by the other converter and thus pulsations of one polarity are strong in one coil while those of the reverse polarity are strong in the other drill coil. This would not probably be a very efficient method.

Another general plan of drill operation, which I will call plan "B," has been developed to some extent by the late Mr. Van Depoele. This plan is based on a difference of phase of current in the two coils. The two outer drill wires are connected to the two regular brushes of the armature, and the middle wire connects with a solid ring connected to one point of the armature. As the armature revolves, current rises in one drill coil and falls in the other, producing the reciprocation of the plunger. The voltage curves for this type of machine are shown by Fig. 4. An armature giving two alternating currents of 90° difference of phase may also be used, but with the disadvantage of reversing the polarity of the drill plunger. The above appears to be less efficient than plan "A" for the reason that the drill coils are constantly working against each other, and being heated up by current opposing the action of the drill.

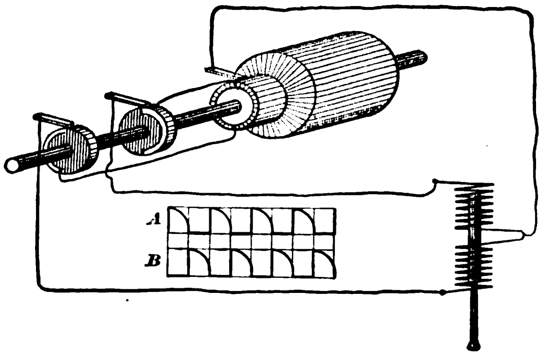

FIG. 3.

A third plan of operation, which we may call plan "C," is that devised by Messrs. Siemens & Halske. Three coils are used in the drill, the middle coil being excited by a continuous current and the two end coils by an alternating current of proper frequency. The function of the middle coil is to maintain a constant polarity in the bar, and the motion is effected by the effort of the two end coils. In this system both motor coils are continuously excited as in plan "B," but there appears to be less waste of energy.

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[1] Abstract of a paper read at the general meeting of the American Institute of Electrical Engineers, Chicago, June 7.

Aside from the extra complication of drill construction it is questionable if as much power can be obtained from a given weight of wire with this arrangement as can be realized on plan "A." It must be borne in mind that in these machines it is necessary to get the utmost power possible out of a given weight of copper and iron, and the heating limit is the only practical consideration. The efficiency of the machine is secondary.

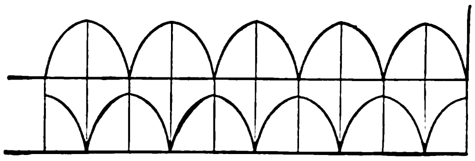

FIG. 4.

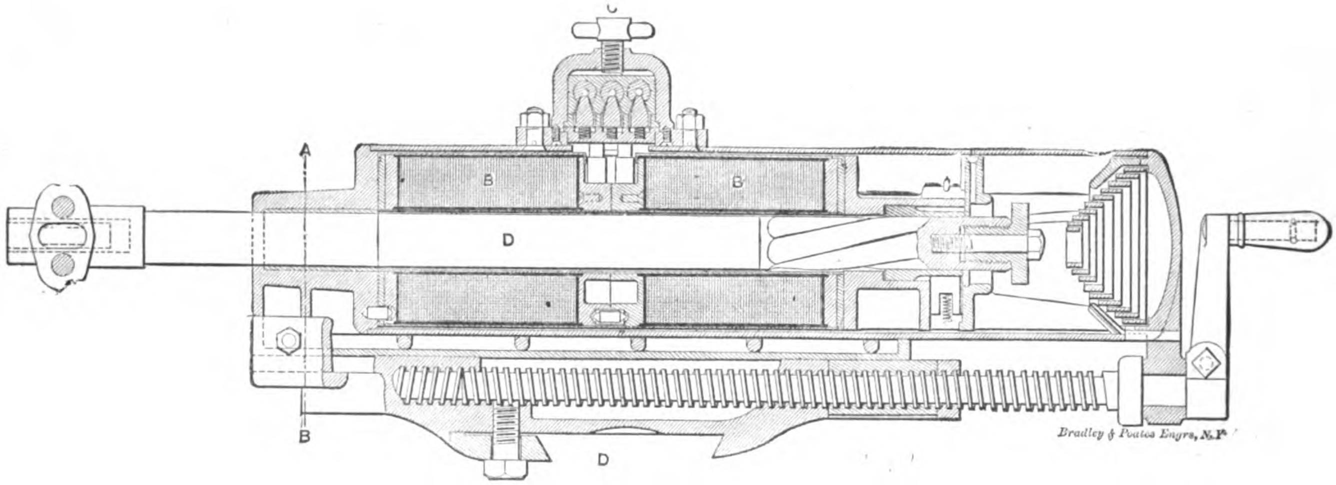

FIG. 6.

Plan "C" has been reduced to practice in this country by the late Mr. Van Depoele, who avoided the use of a fourth wire in the system by an ingenious method shown in Fig. 5. The regular commutator is supplied with rotating brushes B^2 B^3 in addition to the regular brushes B, B^1. It appears that as the rotating brushes revolve a simple alternating current flows through the end coils of the drill, while a unidirection pulsating current of one-half the frequency circulates in the middle coil.

The requirements of construction and service have thus far induced me to employ a rather low voltage in the operation of drills, our present practice being to use about 100 volts alternating upon the drill. I have employed several methods of operating drills from high voltage circuits.

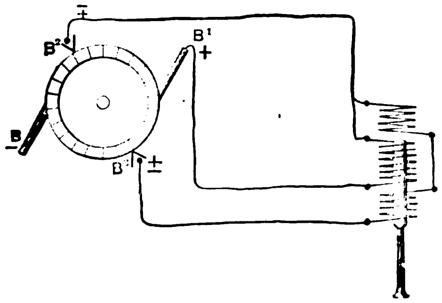

FIG. 5.

Another method is where a 1,000-volt alternating circuit is led from the prime generator to the vicinity of the mine, where it passes through the primary of a converter in which the voltage is reduced to 100 volts. A small motor running in synchronism with the generator directs the alternate pulsations into the drill circuits.

Turning now to the drill construction, Fig. 6 shows the first form in which the percussion drill was put upon the market. This I call a type "A" machine. As appears in the engraving, the machine consists of a seven-inch boiler tube provided with a suitable mounting. Within the tube are two solenoids, B, B, a rotating device and a cushion spring. Traveling through the coils is a two-inch plunger, D, the middle portion of which is of iron; the upper end is of brass and is rifled as shown to fit the rotating device; the lower end is also of brass, and is enlarged at the end into a chuck to hold the bit. The three sections of the plunger are welded together. The weight of this plunger was 38 lbs. This machine was designed to make 600 blows per minute with a three-inch to four-inch stroke. The first of these machines to be put into a mine was that started in May, 1891, in the Black Bear mine at Gem, Idaho. This was, I believe, the first commercial electric percussion drill plant ever operated. During the next few months several other mines and quarries were equipped with these drills, with the general result that where the rock was not excessively hard the work was fairly satisfactory, but in extremely hard rock several defects developed. The brass portion of the plunger would crystallize and break a short distance above the chuck. Under the severe strain of continuous work in hard rock the coils would become so heated as to ground, and the spring connections between the cable and the coils would give out. The construction of these drill coils deserves special description. The coil is constructed as follows: Upon a brass spool, the body and heads of which are insulated with mica, is wound a bare copper wire of square section; this wire is insulated, as it is wound, with mica. The complete coil is wrapped with mica and a metal tube slipped over the whole and soldered to the coil-heads, making the completed coil waterproof and heat-proof, as it is insulated with mica alone, nothing but mica and metal being used in its construction.

The design of the machine was then altered. The plunger was then enlarged to two and three-fourths inches, and is what I call the double-magnet type. The forward part is now made of steel, the rifle part is also of steel, and the connecting piece is of brass. This design gives a solid steel chuck and brings the brass part of the plunger within the drill body. The coils are now encased in boiler-tube jackets brazed up with hard spelter and are heated to a bright red in process of manufacture. The spring connections have been abandoned and solid set screw connections now connect the cable to the drill. A switch is inserted in the cable near the drill. This machine seems to overcome the defects of the old

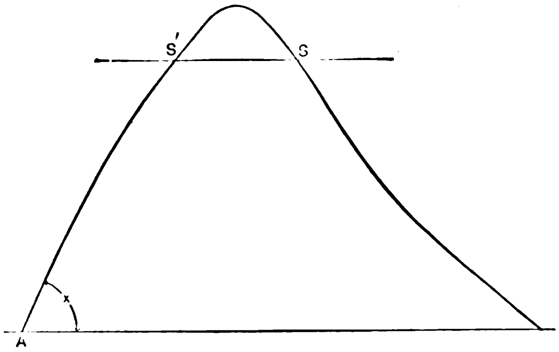

FIG. 7.

drill, and has thus far proved very satisfactory. This machine takes a stroke of about five inches and runs about 380 blows per minute. This longer stroke is found more effective in keeping the hole free from mud.

A still later type of drill that I have recently built, and which promises to be much better than the others, has a plunger of a solid steel forging four inches in diameter. No brass is used in the plunger, the metal being reduced in section where it passes through the front head. The ratchet device is similar to that used in air drills, and, in fact, the whole design of the machine quite closely follows the air drill construction. This machine takes a stroke of from six and one-half to seven and one-half inches, and makes about 380 blows per minute; the plunger weighs 80 lbs.

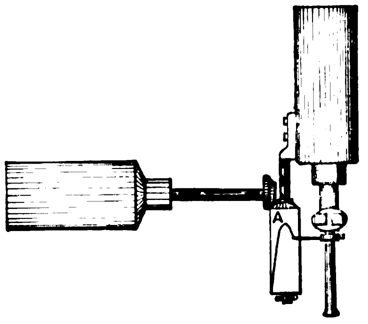

FIG. 8.

Fig. 6 shows the cable connection and switch, A, and the cable fuse-box, B, through which connection is made from the mains to the cable. A study of the operations of these machines presents many interesting features. In Fig. 7 is shown what I term an energy curve of the machine. This curve is obtained in a manner similar to an indicator card of a steam engine, as run in Fig 8. A is a cylinder mounted parallel to the drill-rod. This cylinder is geared to the armature shaft in such a manner that it rotates in synchronism with it. A pencil carried by the drill-rod rests upon the cylinder, A; it follows that as the drill-rod reciprocates, and the cylinder A rotates, a curve will be traced by the pencil.

The direction of motion of the paper being from left to right, it appears that the angle of the curve at any point indicates the velocity of the plunger at the instant. A is the point where the plunger strikes the rock and the sharp rebound is shown by the angle. The buffing spring is encountered at S and S', and the curve shows little loss in the spring. A simple calculation gives the energy of the blow in foot pounds. This affords a good method of comparison between different machines and conditions. The general character of the curve reveals the general action of the forces during the stroke.

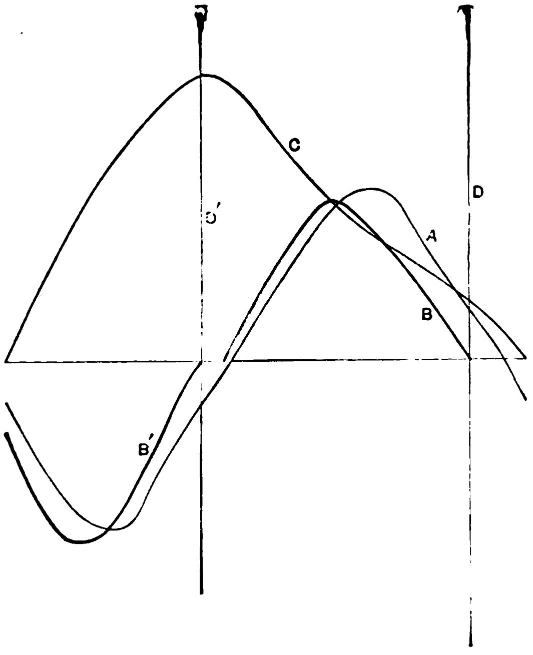

FIG. 9.

Some interesting curves are shown in Fig. 9. Curve A shows the voltage on the drill circuit; curves B and B', the current in the two coils. Curve C is the energy curve. The lines D, D', indicate where the brushes make contact with the half ring.

The efficiency of the above machines, compared with other forms of electric motors, is, of course, low, but this factor is of comparitively little moment in percussion drill work. It is far more important that the machine should be able to endure the development of a large amount of power with a small weight than that it should be highly efficient. It would seem that the general mechanical designs of these machines admit of greater durability and simplicity of construction than air drills, as there are no steam-tight joints required, and a very great wear upon the moving parts does not reduce the effectiveness of the drill. The general flexibility of the electrical system and its peculiar adaptation to mining work are well recognized, but it has been urged that for drill work compressed air is a necessary factor for ventilation. A careful investigation of this matter reveals the fact that there is little or no weight in this objection. The instances are extremely rare where compressed air is relied upon for ventilation and I have found few miners who considered this matter of importance.

Although the introduction of the percussion drill has been attended with many difficulties, I believe that the obstacles have been so far overcome that the machine is to-day in thoroughly practical shape.

ELECTRIC LAUNCHES AT THE CHICAGO EXHIBITION.

THE announcement that the contract for supplying launches to convey passengers on the lagoon at the Columbian Exhibition will be awarded to an electric company is interesting as confirming faith in the feasibility and utility of electric navigation under the conditions to be met at Chicago.

The various craft submitted for test were ten in number, as follows:

Steam	launch	"America,"	submitted by	Willard & Co., Chicago.
"	"	"Isabella,"	"	Meeker & Co., Jersey City.
Naphtha	"	"Chicago,"	"	Gas Engine and Power Co., New York.
Oil	"	——	"	Columbia Launch Co., Chicago.
Electric	"	"Electra,"	"	Electric Launch and Navigation Co., New York.
"	"	"Volta."	"	Columbia Launch Co., Chicago.
"	"	"Ferdinand,"	"	Meeker & Co., Jersey City.
"	cab boat,	——	"	Columbia Launch Co., Chicago.
Hydrocarbon	cab boat,	——	"	Columbia Launch Co., Chicago.
Pneumatic	launch	"Pneumatic,"	"	Willard & Co., Chicago.

Of the above boats only the "America," "Isabella," "Electra" and "Volta" were generally considered to be in the contest for the franchise, some of the others having been submitted as suggestions, especially the "cab boats" (small boats intended not for schedule trips, but for small parties engaging them by the hour.)

The "America" was larger than called for in the specifications, and, although a very creditable boat, the general impression was that this boat was too large for lagoon service. The "Isabella," "Electra" and "Volta," were of about the dimensions called for.

Each boat was tested on a 10 hours' run and each had a special day for the test. They were loaded partly with passengers and partly with sandbags, so as to make full load according to the capacity claimed in each case. The boats were run around the part of the lagoons called the "Basin" and the "Harbor," the length of the circuit being 4,200 feet, of which only a few hundred feet were straight course, the rest being circuitous. On each round trip two landings were made, including a stop of one and a half minutes at each landing by way of exemplifying the conditions under which the boats are to run during the fair. The several boats mentioned made the following records: "America," 53 trips; "Isabella," 48 trips; "Electra," 45 trips; "Volta," 33 trips in 10 hours, including stops. The electric launch "Electra" carried 62 cells on board weighing about 2,400 lbs., and the "Volta" 104 cells, weighing about 4,160 lbs.

While both steamboats named were excellent boats of their class, the performance of the "Electra," together with her attractive appearance and other advantages as compared with steam, gained for this boat a recognition which gradually crystallized into preference, and it effectually demonstrated that electric launches are not merely a possibility but an achievement which the steamboat men were forced to recognize notwithstanding their confident predictions that electricity would fail to come up to the mark. The fact that the performance of other electric boats present failed to equal that of the "Electra" supported the steamboat mens' predictions to some extent, but, thanks to the presence of the "Electra," only to the extent of proving the necessity of proper engineering in electric boats, as in other electrical work, to secure the best results, and that the mere putting of a battery and a motor into a hull does not make a satisfactory boat. The only electric boat approved by steamboat men was the "Ferdinand," which would not go at all and was therefore withdrawn.

The "Electra" performed better in Chicago with 62 cells than in Newark (before shipment to Chicago) with 78, owing to the

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1. For a full description and illustration of the "Electra" see THE ELECTRICAL ENGINEER, June 15, 1892.

fact that all the "kinks" due to warping and swelling of the timbers when the boat was still "green" had been removed and everything brought to a settled and normal condition.

THE ELECTRIC FOUNTAINS AT THE COLUMBIAN EXPOSITION.

AMONG the features of the Columbian Exposition early decided upon was the operation of electric fountains, which have proved to be such attractive features at previous expositions. It was not until recently, however, that active measures were taken with this end in view and the work of designing the fountains undertaken. The Exposition authorities very wisely placed the entire matter in the hands of their consulting electrical engineer, Mr. Luther Stieringer, whose plans were at once adopted and when carried out will result in a display which will far exceed in magnitude and beauty anything of the kind thus far attempted.

The fountains will be located east of the Administration Building, one on each side of the larger fountain at the west end of the basin. They will be much larger and much more beautiful than those at the recent Paris Exposition. To supply them with water there will be a twenty-four-inch main for each, and a pressure of 100 pounds to the square inch will be supplied. This will force the water 175 feet into the air. The jets will be in three rows and will number several hundred.

A bid for the construction of these fountains was last week offered the Grounds and Buildings Committee by Lieutenant Spencer, of the General Electric Company. This bid, which was about $48,000 for the electrical portion and operating during the entire exposition, was referred to Chief of Construction Burnham and will undoubtedly be accepted.

Personal.

MR. A. J. ARNOT.

AMONG the passengers on the "City of Paris" from New York, on Wednesday, August 3, were Mr. and Mrs. A. J. Arnot. Mr. Arnot is the electrical engineer of the corporation of the city of Melbourne, and has been in America for some two months for the purpose of testing electrical apparatus to be supplied by the Thomson-Houston International Electric Company for the public lighting of Melbourne. In addition to this, Mr. Arnot has investigated thoroughly the underground wire practice as it is exemplified in the States, having visited the principal cities where lighting is done by underground service. In England Mr. Arnot will inspect the boilers which are being manufactured for the Melbourne lighting, and in London and on the Continent will visit the principal centres to pursue his investigations in underground work. During his stay in this country Mr. Arnot impressed those who met him with his careful, painstaking methods and thorough knowledge of the subject in hand. The evening before his departure from Boston he was tendered by the board of directors of the Thomson-Houston International Electric Company a dinner at the Algonquin Club, at which President Coffin of the General Electric Company presided. The gentlemen present, besides Mr. Coffin, were Professor Thomson, President Newhall of the International Company, Vice-President Bartlett, Manager J. R. McKee of the Mining Department, General Counsel F. P. Fish and Associate Counsel R. P. Clapp and General Manager Davenport of the International Company.

MR. HENRY W. FISHER, electrician of the Standard Underground Cable Co., has recently been appointed electrician to the Central District and Printing Telegraph Co., of Pittsburgh. This company operates the telephone system of Pittsburgh and the increasing amount of underground wires has made it necessary to employ an expert to superintend the cable work. Mr. Fisher, however, retains his position with the Standard Underground Cable Co., as heretofore.

DR. S. S. WHEELER, president of the Crocker-Wheeler Electric Company, sailed August 3 on the "Germania" for a much-needed vacation. He has taken with him letters of introduction to the leading electricians of Europe, and will also visit the principal central stations abroad.

PROF. F. B. CROCKER, vice-president of the Crocker-Wheeler Electric Co., arrived on the "Teutonic" on August 3 after a six weeks' sojourn abroad. He has seen in this short time nearly every electrical engineer of note, has visited the principal central stations and works of Europe, and has taken a general survey of the electrical field.

THE TROY AND NEW ENGLAND RAILROAD which was supposed to be defunct, has been resurrected, and a meeting of the directors has been called, to broach (it is said) the question of equipping the road with electric power instead of steam.

Inventors' Record.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JULY 26, 1892.

Accumulators:—

Secondary Battery, A. E. Colgate, 479,753. Filed Apr. 26, 1892.

Employs a plate consisting of an assemblage of strands composed of flat strips or ribbons of lead twisted together.

Alarms and Signals:—

Electric Signaling Device for Fire Hose, J. G. Wharton and J. W. Braid, 479,540. Filed Nov. 11, 1891.

Employs a conductor running through each section of the hose and electrically connected with the brass joints and contact pieces for insuring good connection at the joints.

Switch and Signal Apparatus, J. G. L. Schreuder, 479,666. Filed June 10, 1891.

Employs a fluid pressure motor connected with the track and having an electrically controlled valve mechanism and lock.

Key Controller and Signal Transmitter, M. Martin, 479,715. Filed July 16, 1889.

Employs a detachable key for operating the signal transmitter, combined with a detent that engages the key when introduced into the box, an electromagnet to operate the detent and a circuit changer at the central office for operating the electromagnet.

Conductors, Conduits, and Insulators:—

Electric Conductor, F. A. C. Perrine, 479,525. Filed Sept. 23, 1891.

Employs a single strand conductor twisted to a helical form and having a covering of paper supported on the exterior lines of the helix, so as to form air spaces between the conductor and the covering.

Dynamos and Motors:—

Motor-Frame for Electric Locomotives, S. H. Short; 479,469. Filed Oct. 29, 1889.

Has for its object to insulate the motor from the ground by insulating it from the metallic portions of the truck.

Alternating Current Motor, W. Stanley, Jr., and J. F. Kelly, 479,675. Filed Nov. 14, 1891.

Employs a stationary coil closed upon itself and having its convolutions substantially parallel to those of the armature coil so as to neutralize the self-induction of the armature.

Alternating Current Motor, W. Stanley, Jr., and J. F. Kelly, 479,676. Filed March, 5, 1892.

Claim 2 follows:

The combination with an alternating current motor and in series with the circuit or circuits of the same of a polarization cell adapted to yield an electromotive force opposite to that of the self-induction of the motor.

Alternating Current Motor, W. Stanley, Jr., and J. F. Kelly, 479,727. Filed March 8, 1892.

Claim 1 follows:

The combination with an alternating current motor having independent energizing circuits of a polarization cell included in one circuit and a self-induction device in the other.

Electromagnetic Motor, J. F. Kelly, and W. Stanley, Jr., 479,746. Filed May 29, 1891.

Employs a condenser in series with an alternating current motor to neutralize the self-induction.

Galvanic and Thermo-Electric Batteries:—

Sealed Battery Cell or Similar Articles, C. Willms, 479,541. Filed Apr. 30 1892.

A battery cell of glass, having an end sealing plug of plastic material, which expands while setting so as to prevent leakage.

Thermo-Electric Element, C. W. Iden, 479,596. Filed Nov. 11, 1889.

Consists of an iron box with a compound of zinc and antimony cast within it, and pole pieces of some different metal cast in the ends of the zinc and antimony.

Lamps and Appurtenances:—

Cord Adjuster for Electric Lamps, J. W. Heaphy, 479,509. Filed Nov. 11, 1891.

Electric Arc Lamp, W. E. Irish, 479,510. Filed May 4, 1892.

Relates to the combination of a thermo-expansive electric conductor, a clutch, an operating lever and a spring for communicating the motions of the conductor to the clutch, and carbon electrodes engaged with the clutch.

Electric Arc Lamp, J. A. Pierce, 479,659. Filed Oct. 15, 1891.

Employs a bracket attached to the frame of the lamp and to which are pivotally attached swinging arms carrying rollers which embrace the electrode for the purpose of rendering steady the feed of the carbons.

Apparatus for Producing Variegated Lights, F. L. M. Smith and W. J. Bryan, 479,673. Filed Jan. 5, 1892.

An apparatus for advertising signs, etc.

Miscellaneous:—

Cord Carrier for Underground Conduits, S. R. Bradley, 479,397. Filed Jan. 27, 1892.

Consists of a magnet, the armature whereof actuates devices which engage with the interior wall of the conduit so as to propel the carrier forward.

Electric Bell, A. M. Eklund, 479,410. Filed May 2, 1892.

Electric Self-Winding Clock, M. Mackellar and G. D. Weaver, 479,520. Filed Aug. 12, 1891.

Electroplating Toy Apparatus, E. A Clark, 479,557. Filed Mar. 16, 1892.

Temperature Regulator, W. H. Kilbourne, 479,761. Filed May 13, 1891.

Employs a thermostat bar connected with a hot water radiator, electrical devices connected with the thermostat, and rods connected with the electrical devices for operating valves or dampers.

Matrix-Making Machine, G. A. Goodson and A. C. Capehart, 479,772. Filed May 31, 1887.

Employs an electromagnetic feed mechanism and electrical contacts corresponding with each group of dies and connections from the same to the feed mechanism.

Matrix-Making Machine, G. A. Goodson, 479,773. Filed Mar. 20, 1888.

Similar to No. 479,772.

Railways and Appliances:—

Electric Railway, M. W. Dewey, 479,493. Filed July 24, 1891.

Employs a condensing plate upon the vehicle carried in inductive proximity to the line conductor.

Trolley, F. F. Poole, 479,608. Filed May 11, 1892.

Employs spring plates adjustably secured to the sides of a support and fulcrumed on the axle and metal blocks, so arranged on the springs as to touch the wire beyond, but in the centre line of the trolley wheel.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED AUGUST 2, 1892.

Accumulators:—

Storage Battery Plate, H. G. Osburn, 479,835. Filed Nov. 21, 1891.

Consists of longitudinal webs and transverse bars deflected alternately in opposite directions.

Alarms and Signals:—

Electric Signal Apparatus, A. J. Wilson, 479,928. Filed Nov. 9, 1891.

Has for its object to permit the presence of more than one train at a time on the guarded block without the passage of one train from the block clearing the signal behind another following train or trains that may still remain.

Fire-Alarm Telegraph Indicator, F. F. Loomis, 479,950. Filed Dec. 1, 1891.

A fire-alarm circuit provided with boxes, which shall automatically indicate by figures the number of the box from which the alarm is given.

Train Order Annunciator, L. T. Crabtree, 480,078. Filed Oct. 15, 1891.

Automatic Device for Electric Block Signals, J. B. Stewart, 480,147. Filed Jan. 26, 1892.

An electric locking device comprising a circuit, including magnets at each station and batteries opposed to each other on the line.

Conductors, Conduits and Insulators:—

Insulator, J. J. Green, 480,011. Filed Mar. 24, 1892.

Provides means whereby the conductor, having been first introduced into a transverse groove in the insulator, is fixed in place by simply turning the insulator upon the screw supporting it.

Distribution:—

System of Distributing Electric Currents. C. J. Van Depoele, deceased; C. A. Coffin and A. Wahl, executors, 479,964. Filed May 20, 1891.

Has for its object to supply currents capable of operating a number of different types of machines with the use of the smallest possible quantity of copper in the conductors.

Dynamos and Motors:—

Commutator, W. H. Elkins, 479,793. Filed Jan. 26, 1892.

Employs a number of individually insulated segments and alternate segments having contact portions in different planes of rotation.

Brush Holder, F. J. Haeseler, 479,802. Filed Nov. 5, 1891.

Employs a copper and carbon brush in contact with one another.

Electromagnet Bobbin, E. B. Hatch and C. A. Colton, 479,804. Filed Jan. 13, 1892.

Employs projecting flanges of partially vulcanized india-rubber and asbestos composition in a single piece and helices of wire wound about the bobbin between the flanges.

Influence Generator of Electricity, W. Henry, 479,941. Filed May 29, 1891.

Employs two groups of insulated metallic sectors placed in relatively different inductive proximity to one another so that polarization shall take place in the induced sectors at different moments.

Pulsating Current Generator, H. N. Marvin, 479,951. Filed Dec, 3, 1891.

Employs brushes capable of being rotated about the commutator and means for establishing connection alternately between the brushes and the circuits of a drill.

Controling Mechanism for Reciprocating Electric Engines, C. J. Van Depoele, deceased; C. A. Coffin and A. Wahl, executors, 479,960. Filed Dec. 31, 1889.

Employs a circuit supplying alternating currents to the motor coils and means for regulating and controling the current strength and also the number of alternations or phases in the motor coils.

Feed Mechanism for Electric Reciprocating Engines, C. J. Van Depoele, deceased; C. A. Coffin and A. Wahl, executors, 479,961. Filed May 22, 1890.

Reciprocating Electric Engine, C. J. Van Depoele, deceased, C. A. Coffin and A. Wahl, executors, 479,962. Filed Sept. 19, 1890.

Comprises a plurality of motor coils, a magnet plunger therein, a generator having an armature of the continuous current type and means for dividing the current of the generator.

System of Supplying Currents to Reciprocating Electric Engines, C. J. Van Depoele, deceased; C. A. Coffin and A. Wahl, executors, 479,963. Filed April 11, 1891.

Dispenses with moving parts upon the commutator and substitutes additional contact surfaces provided with insulated portion and from which the current is collected by stationary brushes.

Field Magnet Frame for Dynamo-Electric Machines, E. P. Warner, 480,049. Filed Feb. 10, 1890.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, M. M. Clark, 479,786. Filed Jan. 9, 1892.

A dry battery employing a porous cup immersed in the electrolyte, a negative element within said porous cup and surrounded by a depolarizing substance, a packing of fibrous material above the electrolyte and a tube secured to the positive element and extending through the sealing material and having a closing cap.

Galvanic Battery, F. de Lalande, 479,887. Filed June 27, 1891.

Employs an electrode consisting of an agglomerated mass of copper oxide having its surface reduced to a metallic state.

Heating:—

Electrical Water Heater, R. Kennedy, 479,814. Filed April 1, 1891.

Lamps and Appurtenances:—

Incandescent Lamp Guard, G. W. Demmick, 479,791. Filed June 22, 1889.

Spark Arrester for Electric Arc Lamps, C. Smallwood, 479,994. Filed Dec. 26, 1891.

Duplex Arc Lamp, E. P. Warner, 480,050. Filed Feb. 21, 1891.

Employs two pairs of carbons placed in derived circuit, a unitary electromagnetic device for controling them and a polarized commutator to transfer the arc from one pair of carbons to the other.

Reflector, C. A. Meadows, 480,201. Filed Dec. 31, 1891.

Measurement:—

Electric Meter, L. V. Brillié, 479,932. Filed Oct. 2, 1891.

A "motor-meter" in which the current passes through an electro dynamometer, the speed of the motor being regulated by a current-regulator controler.

Device for Measuring Electrical Currents, C. H. Rudd, 480,089. Filed Nov. 6, 1891.

Employs a measuring coil concentric with and in the field of a field coil and movable with respect to the latter and a telephone in the circuit of the measuring coil.

Miscellaneous:—

Process of Purifying Liquors, C. W. Brunson, 479,781. Filed Nov. 9, 1891.

Claim 5 follows:

The process of purifying spirituous liquor or other liquid by means of the application thereto of electrolysis, while said liquor or liquid is kept in a state of frigidity approximating its freezing point.

Valve Controler, C. L. Fortier, 479,795. Filed March 5, 1892.

Electric Steering Gear, E. H. Mumford, 479,828. Filed Aug. 20, 1891.

Employs a curved arm of magnetic material attached to the tiller and a solenoid fixed to the body of the vessel and receiving within its coils a portion of the curved arm

Device for Indicating Washouts in Railroad Beds, J. Ortega y Espinosa. 479,834. Filed Oct. 23, 1891.

An arrangement for electrically indicating at railway stations any washouts of the roadbeds or bridges as may occur along the line.

Electric Current Regulator, A. S. Krotz, 479,886. Filed March 26, 1891.

Employs a solenoid included in shunt circuit, an electromagnetic device included in the main circuit and maintaining the shunt circuit normally open, devices connecting the core of the solenoid with the generator and means for automatically controling the number of solenoid coils included in the shunt circuit.

Mold for the Manufacture of Electrical Switchboards, J. B. Lyon, 479,891. Filed Jan. 19, 1891.

Elevator, L. M. Hosea, 479,913. Filed Aug. 21, 1891.

An electric elevator having fixed suspension ropes secured at the top of the runway and wound over sheaves actuated by a motor carried upon the car.

Reciprocating Electric Drill, F. F. Loomis, 479,948. Filed April 11, 1891.

Has for its object to increase the force of the stroke and insure a quick return by alternately increasing and reducing the attraction of the solenoid.

Reciprocating Electric Pile-Driver, C. J. Van Depoele, deceased; C. A. Coffin and A. Wahl, executors, 479,965. Filed May 23, 1891.

Electrical Transmission of Power, C. J. Van Depoele, deceased; C. A. Coffin and A. Wahl, executors, 479,966. Filed May 6, 1891.

Relates to means for the distributing of pulsating currents for reciprocating engines, rock drills, etc.

Testing Apparatus for Electric Lighting Circuits, C. H. Rudd, 480,088 Filed Dec. 10, 1888.

Has for its object the localization of the first accidental ground that may be formed in order that the damage may be repaired.

Electric Jail-Plate, W. S. Hull, 480,099. Filed Dec. 8, 1891.

Electric Screens for Doors or Windows, W. S. Hull, 480,100. Filed Feb. 3, 1892.

Rheostat, C. W. Tobey, 480,151. Filed July 11, 1891.

Consists of powdered graphite and asbestos compressed into a compact body.

Electric Cord Tip, C. W. Tobey, 480,152. Filed Nov. 24, 1891.

Railways and Appliances:—

Closed Conduit for Electric Railways, E. H. Johnson, 479,809. Filed Feb. 10, 1887.

Employs two separate conduits carrying working conductors and two contact carriers connected with the car and moving in said conduit.

Electric Railway, C. H. Baker, 480,004. Filed Sept. 1, 1891.

Has for its object to thoroughly protect the conducting wires in the conduit and at the same time provides efficient means for conducting the current from them to the motor.

Trolley for Electric Cars, G. E. & C. W. Purple, 480,240. Filed Sept. 8, 1891.

Employs dogs upon the supporting yoke of the trolley wheel having inclined upper surfaces and projecting over the wheel.

Switches and Cut-Outs:—

Electric Switch, A. P. Lundberg, 479,821. Filed Dec. 29, 1891.

A rotary switch having angular contacts and contact springs, and in which the base and cover form bearings for the spindle.

Electric Switch. F. F. Loomis, 479,949. Filed July 31, 1891.

Employs a tank containing an acid metallic solution, and a revolving nonconducting cylinder mounted therein and partially covered with a conducting plate and brushes resting on the cylinder.

Safety Cut-Out, R. Furgang, 480,009. Filed Oct. 14, 1891.

Telegraphs:—

Mechanical Telegraph Instrument, B. F. Butler, 479,782. Filed May 16, 1892.

A device by which students may learn the art of telegraphy without the employment of magnets, batteries, etc.

Telegraph Key, A. F. Tucker, 479,859. Filed Mar. 24, 1892.

A telegraph key provided with an automatic switch, whereby the circuit is normally closed when the instrument is not in use.

THE COST OF MAGNETIC CONCENTRATION.

IN a recent paper on magnetic concentration, at the Tilly Foster Mine, F. H. McDowell, of this city, reports the results of work as follows:

From the time the plant was put in operation, in 1890, to January 1, 1892, there have been 78,915 tons sent to the mill, of which 60,827 tons came from the dump and 18,088 from the mine, and the total concentrates shipped to January 1, 1892, were 27,462 tons. The cost of making one ton of concentrates has been reduced from $2.10 in 1890 to $1.99, and this has been accomplished in the face of an abnormal increase of expenses, due to the shortened season brought about by the drought, the laying of drains for the new reservoir system, the building of walls for the increased storage of the tailings and the purchase of several new cars.

THE ELECTRICAL ENGINEER ABROAD.

THE following letter speaks for itself:

ISMAY, IMRIE & CO., WHITE STAR WORKS,
STRAND ROAD, BOOTLE, July 7th, 1892.

TO MR. T. W. SEWELL,
Chief Engineer S. S. "Majestic."

You will please purchase when next in New York six of the Ries regulating lamp sockets, mentioned in accompanying article from THE ELECTRICAL ENGINEER, sending same to this address upon your return.

Yours very truly,
ISMAY, IMRIE & CO.,
Per S. GORDON HOSBURGH.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

An "ad" reaches the mountains as well as the seashore.

THE HAMMER ELECTRIC CLOCK.

Correct time is so essential to the conduct of modern business and social life that the efforts to place the public in possession of reliable time-pieces ought to be encouraged in every way. For the distribution of standard time, electricity is eminently adopted and among the recent applications in this domain is the electric clock system of Messrs. E. G. Hammer & Co., of Brooklyn, N. Y.

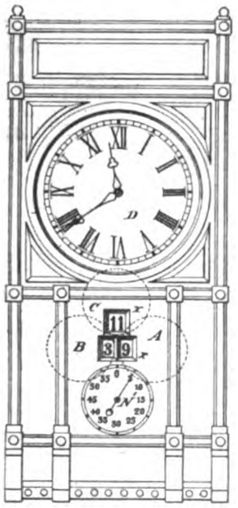


Fig. 1.

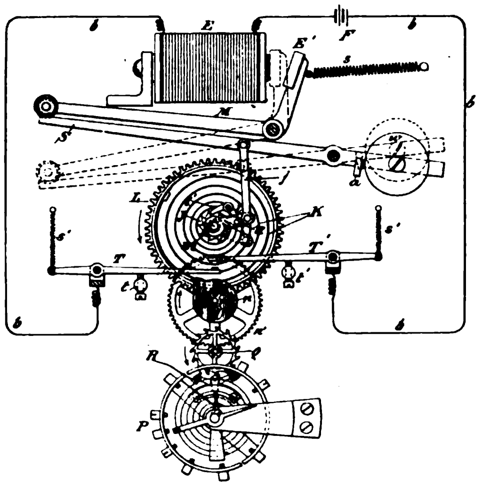


Fig. 3.

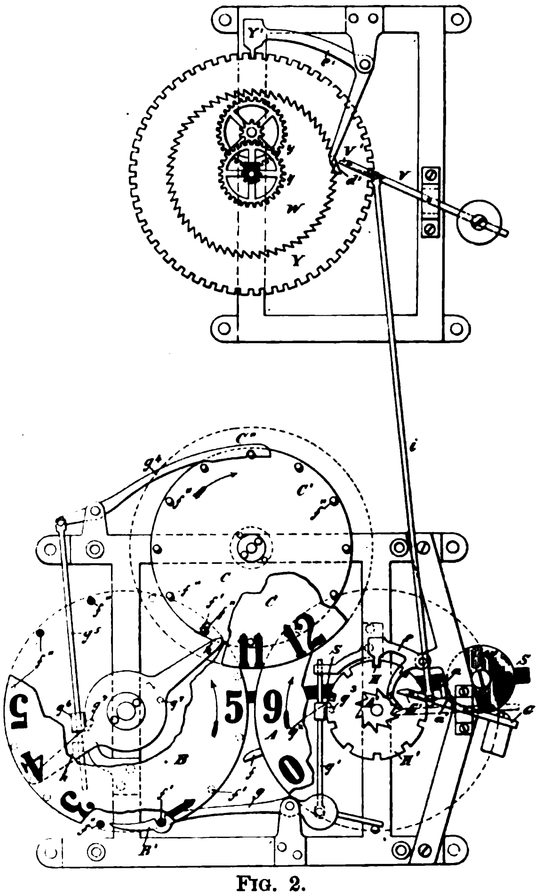


Fig. 2.

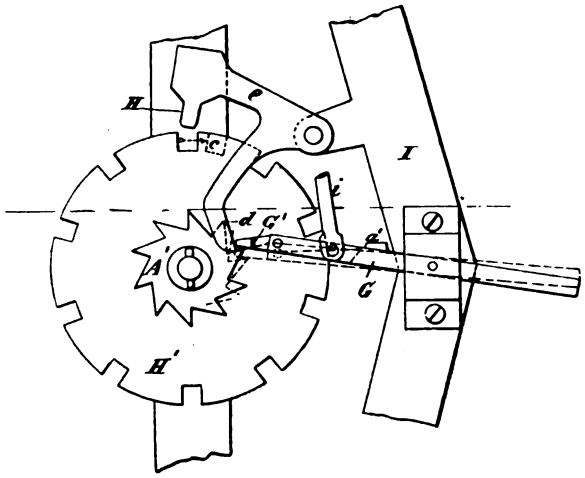


Fig. 4.

Hammer Electric Clock.

In the accompanying engravings, Fig. 1, represents an independent electric clock complete, showing time in two ways, by hands and dial D, and by figures showing railroad time painted on discs, A, B, C. Fig. 2 shows the interior of this arrangement from which it will be seen that this duplex system may be separated so that it leaves a secondary hand clock as well as a secondary figure clock. Fig. 3 shows the simplicity of the turning construction, which is easily explained. It consists of a notched wheel H′ and a ratchet wheel A′ a lever *e* with a bolt H and the other end S on which acts a reciprocating tooth G′, which turns loosely in lever G. It is shown as lifting bolt H out of a notch and is ready to turn ratchet wheel A′; at the same time it leaves point J and thereby allows bolt H to fall in the succeeding notch. This simple device can also be applied to an ordinary hand clock as the upper portion of Fig. 2 shows.

Fig. 4 shows an escapement which may be attached to this secondary clock whereby it becomes an independent clock, spring K which drives the escapement being wound once every minute by a counter-weighted lever S, which also sets the time-indicating service. Contact points T T excite magnet E, and thereby lift through intermediate lever M weight W which, after the breaking of the contact becomes free to act. One of the principal points in this construction, besides its simplicity, is the fact, that the electric current itself does not do any special work except to lift a weight, which weight does the actual work; and as weights do not vary it becomes evident that this mechanism must work very steadily. This secondary hand clock would be eminently fitted to be run in connection with electric railroads or electric light stations as they are simple, durable and precise.

THE WILDER DUPLEX FIRE-ALARM AND MESSENGER COMPANY.

Mention has been made from time to time regarding the incorporation of the Wilder Duplex Fire Alarm and Messenger Company, but as to the nature and extent of the business being done nothing has really been said. It will be of interest to persons contemplating any system of protection for vaults, messenger service, etc., to know that the system of this company is now in use in Kansas City, there being at present about 500 district messenger boxes as well as a complete system of burglar alarms. Mr. E. F. Mullay is secretary and manager.

At Little Rock, Ark., there are at present in use over 300 No. 10 call boxes, and the city of Wichita, Kan., has purchased the system and will use it for fire-alarm and messenger calls. The office of the company is at 167 Broadway, New York, where they have in operation a complete system showing the many advantages claimed for their particular apparatus. Mr. A. M. Sloss, the genial manager, is pleased at all times to explain the workings of the machines.

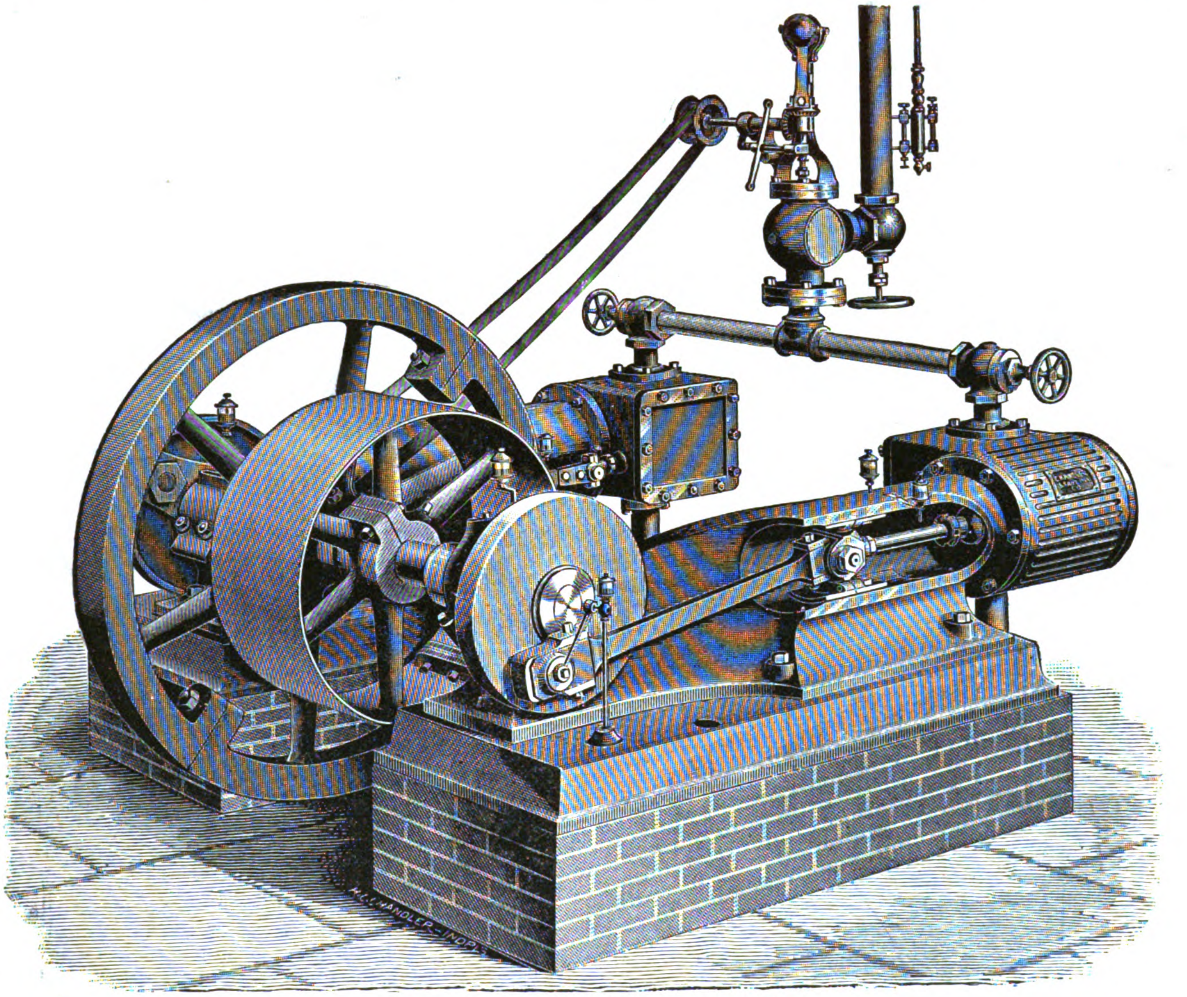
The Enterprise Electric Co., of Chicago, have opened a St. Louis branch house at No. 15 North 9th street. They will carry an assortment of staple electrical supply goods. This will enable them to handle their large trade to the very best advantage in that section.

THE CHANDLER & TAYLOR TWIN ENGINE.

THE accompanying illustration shows a new form of engine lately introduced by the Chandler & Taylor Co., of Indianapolis, Ind. As will be seen, the arrangement consists of a right and a left-hand engine coupled quartering, with crank discs on the ends of shafts, and dispensing with outboard pillow blocks. A comparatively small fly-wheel is required for this type of engine, and where great regularity is not necessary, this may be dispensed with and the turning still be sufficiently uniform for the purpose. The working strains are also more equally distributed than with a single-cylinder engine. The engine is so constructed as to admit of high rotative speed when desired, as in electric light plants, etc.

To render unnecessary the removal of crank discs, which are both permanently fixed, the band wheels and eccentrics are made in halves, which saves work and avoids the possibility of throwing out a crank while removing and replacing a disc.

The governor is at the centre of the connecting pipe, and by means of valves either engine may be shut off without affecting the other. These engines are also fitted with a link motion.



CHANDLER & TAYLOR TWIN ENGINE.

BALL ENGINES.

THE BALL ENGINE Co., of Erie, Pa., have shipped during the past three weeks the following: Compania Mexicana y Luz Electrica, City of Mexico, two 60 h. p. engines, two 60 h. p. heaters, etc.; Hot Springs Electric Co., Hot Springs, Va., one 100 h. p. engine, two 80 h. p. boilers, one 200 h. p. heater, one 200 h. p. pump; Ames-Bonner Co., Toledo, O., one 80 h. p. engine; Brooklyn Navy Yard, Brooklyn, N. Y., one 80 h. p. engine; Arnold Ore Mines, Ferrona, N. Y., one 35 h. p. engine; Northwestern Supply Co., Tacoma, Wash., one 25 h. p. engine; Carbon Iron Co., Pittsburgh, Pa., one 130 h. p. engine; Diamond Light and Power Co., Sheldon, Ia, one 80 h. p. engine; North Hudson County Railroad Co., Hoboken, N. J., one 250 h. p. engine; Puget Sound Pulp and Paper Co., Everett, Wash., one 25 h. p. engine; Pittsburgh Iron and Steel Engineering Co., Pittsburgh, Pa., one 130 h. p. engine; Whitman & Barnes Mfg. Co., Akron, Ohio, one 80 h. p. engine; Fort Clark Street Railway Co., Peoria, Ill., one 130 h. p. engine; Boulder Electric Light Co., Boulder, Col., one 100 h. p. engine, one 100 h. p. boiler, one 150 h. p. pump, two 100 h. p. heaters; Shamokin Electric Railway Co., Shamokin, Pa., one 130 h. p. engine; North Avenue Street Railway Co., Baltimore, Md., two 130 h. p. engines; Mt. Vernon Electric Light Co., Mt. Vernon, Ohio, one 150 h. p. engine; H. F. Watson & Co., Erie, Pa., one 350 h. p. cross-compound engine; Rock Cut Clay Co., Lim., Alfred Centre, N. Y., one 60 h. p. engine; Metropolitan Telephone Building, New York City, one 60 h. p. engine; La Gran Fundicion Nacional Mexicana, Monterey, Mexico, one 60 h. p. engine.

PACKARD ARC LAMPS.

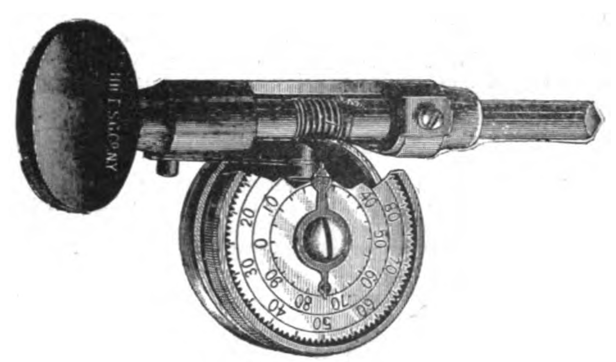
THE ELECTRIC APPLIANCE COMPANY report having secured the general Western agency for the Packard lamp and will hereafter handle the Western trade from Chicago. The Electric Appliance Co. are certainly to be congratulated on their success in adding the Packard lamp to their large line of very desirable specialties. They have been controlling the sale of the Packard lamp in Indiana and Southern Michigan for some time and have met with such large success in that territory that the New York & Ohio Co. have decided to give them control of the Western territory. Arrangements are being made to carry a large stock of lamps in Chicago for the accommodation of the trade.

There is probably not another lamp on the market which has enjoyed such a reputation from the first day it was put on the market. There may be other good lamps to-day but they have gradually worked up to that point through failures and imperfections, whereas the Packard lamp was a perfect lamp from its inception and its brilliant record has been continuous.

ONE of the handsomest isolated plants being put in at present is that in the power station of the Broadway Cable Road. The plant will comprise between 3,000 and 4,000 lamps, and quite a number of electric motors. Slow-speed dynamos, coupled directly upon the engine shaft, will be used. H. Ward Leonard & Co. are acting as the bulk contractors for the entire electrical equipment.

THE GEM ALARM BELL INDICATOR.

THE accompanying illustration shows one of the neatest and most useful pocket tools for electricians and others that have been lately put on the market, known as the "Gem" double-speed alarm bell indicator. It is a combination of a speed indicator and alarm bell. It is nickel-plated, and in size is only 3⅝ x 1¼ x ⅞ inches, and may be easily carried in the vest pocket. In use the engaging point is applied to the shaft of the machine being tested, and the operator, watch in hand, waits until the bell rings. Upon the ringing of the bell, he begins to observe the time and continues as long as may be desired, it being simply necessary to count the strokes of the bell thereafter, each stroke indicating 100 revolutions. Upon the expiration of time limit the indicator is removed and any fraction of 100 that may be shown upon the dial is added to the full hundreds previously counted by bell strokes.



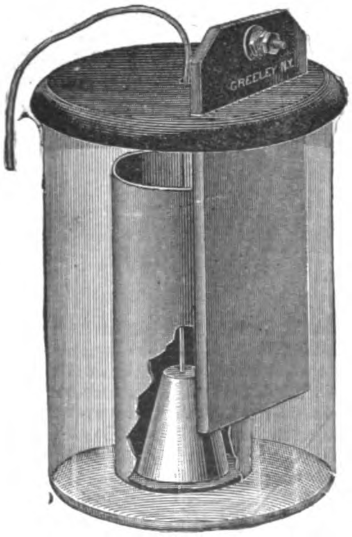
GEM ALARM BELL INDICATOR.

This instrument will be readily appreciated by all who have to do with machinery and engines of any kind.

The E. S. Greeley & Co., 5 and 7 Dey street, New York, who are introducing these instruments, anticipate a very large sale for them.

THE FULLER BATTERY.

THE accompanying illustration shows a telephone batttery especially adapted for use in cities where telephones are almost constantly in use, and on long-distance lines, over which extended conversations are held. Much attention has been given to this form of battery by some of the largest telephone companies in this country and after many trials and exhaustive tests has won their expressed approval.



IMPROVED FULLER BATTERY.

The main features claimed for this type of Fuller battery are high efficiency, durability and uniformity of strength. This battery is sold by The E. S. Greeley & Co., 5 and 7 Dey street, New York City.

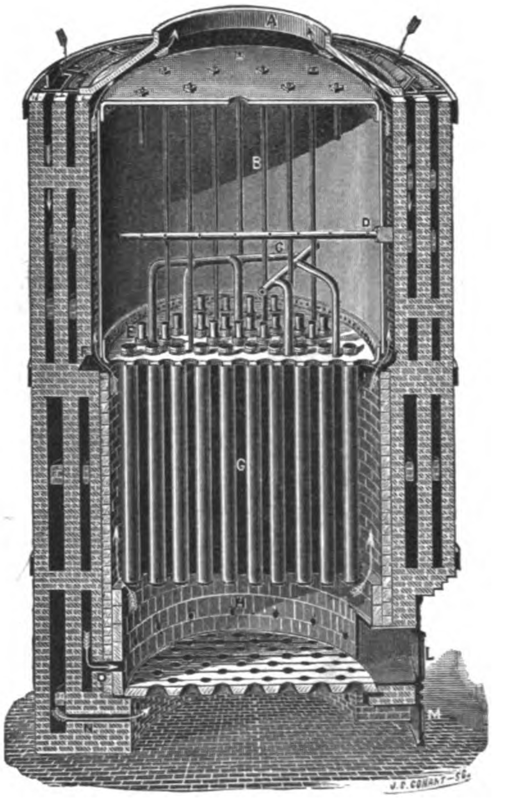
MR. JOHN R. MARKLE, the pioneer electrical expert of Detroit, Mich., called at the Western office of THE ELECTRICAL ENGINEER last week.

THE McLAUTHLIN SAFETY BOILERS.

Two 125 h. p. drop tube safety steam boilers, manufactured by Messrs. George T. McLauthlin & Co., of 120 Fulton street, Boston, were recently installed in the new station of the Atlanta Traction Co., Atlanta, Ga., where they are giving the utmost satisfaction. The results of a test in comparison with tubular boilers, we are informed, showed a saving of nearly 600 pounds of coal per day for three days in favor of the McLauthlin boilers with the same power and conditions.

The accompanying illustration shows a sectional view of one of these boilers, as now manufactured. Here H is the furnace with firebrick lining, which extends up to the supporting ring F, and is set flush with its lower edge. The ring F rests upon the brick-work, and supports the boiler by lugs extending underneath the cylinder; above it the brick-work is laid flush with its upper edge. B is the steam and water cylinder. The two heads are stayed by the vertical braces B, a part of which are broken away to better show other parts. At A is the smoke bonnet, which has its aperture over the centre of the boiler.

The feed-pipe, D, extends across the boiler inside, far above the tube-sheet; it is closed at the end, and perforated so as to secure extended distribution of the feed water in minute upward jets. C is the blow-off pipe, having several branches which dip down to within a quarter of an inch of the tube-sheet; so that all the water blown off is sucked up from the spaces between the tubes, thus securing a clean boiler. The tubes, G, extend through the tube-sheet, and the circulating tubes, E, extend above them. The latter are not shown in the front row.



McLAUTHLIN SAFETY BOILER.

The company claim great safety for their boilers through the following features: The tubes can expand without affecting the cylinder, which, being enveloped by the passing gases, has equal heat throughout every horizontal section; so that no undue strain or change of texture can take place by any possibility of irregular expansion. The manifold blow-off, in connection with the enforced circulation, keeps the boiler throughly clean throughout. The boiler is suspended entirely within the fire-chamber, and free from contact with the brick-work. It has a central fire beneath, an annular draught-space around, and a central draught-flue above, securing a systematic distribution of heat upon all portions of the boiler, and avoiding contact with corroding and heat-conducting surfaces. The distributive feed, in fine upward jets, secures instant vaporization, avoiding the possibility of water coming in contact with overheated surfaces.

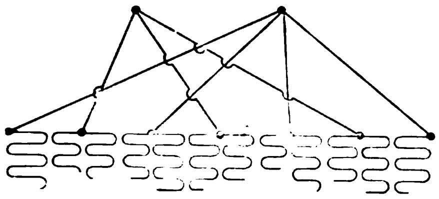
These boilers are carefully built, and are tested at a pressure of 200 pounds.

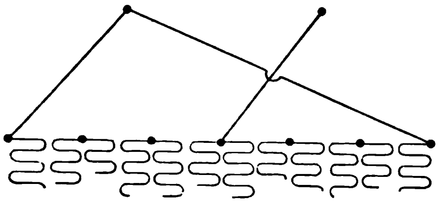
W. E. READ & Co., No. 339 "The Rookery," are the agents for the McEwen engines and boilers, especially built for electric lighting and street railway work.

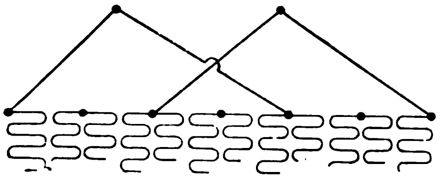
THE CARPENTER ENAMEL RHEOSTAT.

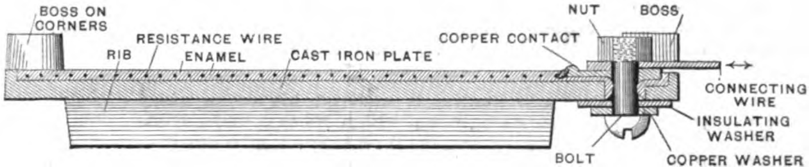
The accompanying illustrations show an exceedingly simple and compact form of rheostat manufactured by the Carpenter Enamel Rheostat Company, of Bridgeport, Conn.

The principle of this rheostat is the conduction and dissipation of heat by holding a resistance wire in close relation to a metal plate so that the heat generated in it by the passage of a current is rapidly conducted to the plate, which becomes the radiating surface. This is accomplished by the use of an enamel which permanently attaches the wire to, but insulates it from, the radiating surface plate, and which also completely surrounds and protects the wires from chemical action. In practice it is found that a wire that will carry a certain current when exposed to the air, will carry ten times that amount of current safely in this rheostat. On this principle, since the cross-section of the conductor can be greatly reduced, it follows that its length can be also proportionately shortened for any required resistance, and no consideration of mechanical strength of the wire enters into this construction since it is so perfectly confined and supported on all sides. For example: A 24 B. and S. German silver wire will, in this rheostat, carry 25 amperes and 80 feet of the wire coiled upon the surface of a plate 10x10 inches, will absorb and dissipate five kilowatts of energy in starting a five-kilowatt motor of 220 volts under full load.

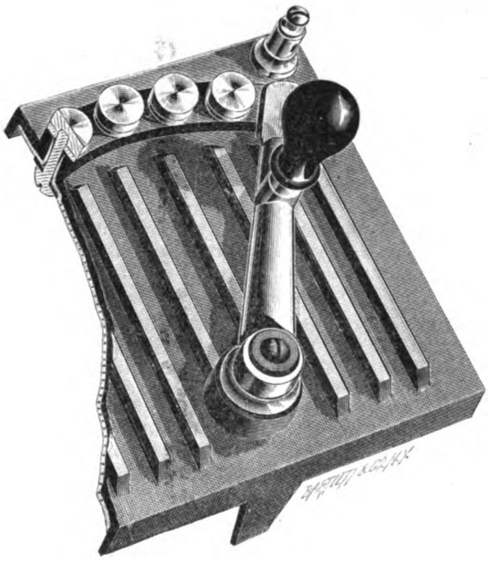








Section of Standard Rheostat Plate



Figs. 1, 2, 3, 4 and 5.—Carpenter Enamel Rheostat.

To increase the radiating surface, the back of the plate is provided with ribs shown in Fig. 4. The plates will dissipate continuously 8 watts per square inch of one surface, *i. e.*, a 10x10 inch plate, or 100 square inches, will dissipate 800 watts, and the temperature will be entirely safe. These plates will carry for a few seconds a current two and a half times as large as that for which they are rated, for continuous service. Standard plates are rated for continuous duty on the basis of 4 amperes per kilowatt when used as a starting rheostat for a 220-volt motor.

The standard plates have always an even number of steps, and, by connecting in various ways, various resistance and current capacity may be obtained. For example, plate No. 1, having 40 ohms with capacity for 5 amperes, and 6 steps, has 6.6 ohms per step. By connecting as indicated in Fig. 1, a plate is secured having a capacity of 30 amperes and 1.1 ohm. The second arrangement shown in Fig. 2, gives for plate No. 1 a capacity of 10 amperes and resistance of 10 ohms; the third arrangement (Fig. 3) of plate No. 1 gives 15 amperes capacity, with 4.4 ohms.

Figs. 4 and 5 shows a standard Carpenter rheostat. It will be noticed that the same iron plate which carries the switch contacts and lever has the coating of enamel on its under side, with the wires embedded in the enamel, so that the rheostat occupies an extremely small space.

The fireproof and waterproof qualities will be evident from the illustration, as will also its compactness, mechanical strength and simplicity.

Some of the other advantages claimed for this valuable instrument are great compactness, simplicity, durability and cheapness.

INSULATING MATERIAL AND INSULATING PAINT.

The effect of intelligent effort, directed by successful business ability, has seldom been better illustrated than by the proportions which the department for insulating materials of the Roessler & Hasslacher Chemical Co., of New York City, has assumed in the last two years. Their contracts for the "Isolatine" insulating material for delivery during this year aggregate three times the amount they were a year ago, while the sales of insulating paint since January are more than four times as large as those of the whole preceding year. Their largest business, however, was done in their protecting paint used by electric railways and steam railroads for poles, bridges, etc., in which field they successfully battled against asphalt and mineral paints.

Its high electric resistance being readily admitted by every user, the permanent pliability of Isolatine, or of the dry coat of Isolatine paint, appears to have rendered unnecessary the usual time tests, and progress in the introduction has on that account been rapid.

The latter point, permanent pliability, also holds good for the paint for protecting iron and wood against weather and soil, while the fact of its great insulation resistance is *prima facie* evidence that it will absolutely exclude moisture.

The firm count among their steady customers electric roads in New Jersey, Philadelphia, Washington, Pittsburgh, Baltimore, etc., who not only employ Isolatine paint for all their insulation work, but also for painting iron and wooden poles, etc., while, after exhaustive experiments, a number of large railroads have sent in their trial orders.

The present outlook augurs well for a still larger business during the last half of the year in this deservedly popular product.

CENTRAL ELECTRIC COMPANY.

The Central Electric Company have got in a large stock of wheatherproof wire, in double and triple braid, and are making prices to suit the customer. The success with the Lundell Fan Motor is very encouraging, and they are selling a large number. Orders for Interior Conduit are still rolling in, and the Central Electric Company can be congratulated upon the maintenance of their large business during the warm weather.

"AMERICA'S GREATEST RAILROAD."

The New York Central has once more given undoubted evidence of its desire and intention of giving its patrons the best possible protection. The company have but recently given, in connection with their block system, which is well nigh completed, an order for some 800 miles of Kerite aerial conductor wire. This is the largest single order for wire ever placed in the country. Kerite is old and tried. The father of the telegraph used it, and was always pleased with it, and there is no reason to believe it will fail now when called upon to do its duties in preventing accidents and loss of life on the lines of the "only four-track railroad in the world."

WESTERN NOTES.

Mr. Chas. E. Gregory, of 313–317 South Canal street, Chicago, is doing a good business at his trading store. Some of his sales during the past month were as follows: Lighting plant for a dredge at the World's Fair grounds; a 30 arc light plant to the Berlin Mantello Granite Co., Mantello, Wis.; 25 arc light plant to Archer Electric Co., Chicago; 60 arc light plant to O. V. Bachelle, Chicago; 15 arc light dynamo to Henne & Co., Chicago; 150-light incandescent to Saratoga Hotel, Chicago; 110-light incandescent to H. Ingraham, Co., Chicago; and 256 cells of storage battery to Patton Motor Co. and other Chicago parties; ten arc lamps to Charlotte, Mich., and 13 Ellis oil filters; one 25 light Sperry dynamo to Holt & Follett, West Plains, Mo.; 1 h. p. Mayo motor to Hiller & Wohl, Chicago.

Mr. Albert Blanchard has lately severed his connection with the Pond Engineering Co., with which he has been connected for more than five years, and is now located at room No. 427 "The Rookery," as an engineer and contractor in steam specialties. Mr. Blanchard is prepared to submit plans and estimates for plants of any desired capacity. His long experience in building car plants for electric lighting and street railway central stations, and as a contracting engineer and superintendent of the construction of numerous steam plants enables him to give the best of references and guarantee satisfaction.

The Electric Appliance Company announces the securing of the agency for the celebrated Elkhart transformer, and will handle the Western trade. The Elkhart transformer has had a record remarkable in a great many respects. It began its career in a quiet way about a year ago, and the manufacturers claim that they have never yet sent out a sample machine that has not resulted in securing them the transformer business of the customer. It is now being used exclusively by a number of the largest plants in the country who could not be induced to make a change at any price.

The Enterprise Electric Co., of 313–315 Dearborn street, Chicago, have found their St. Louis trade increasing so rapidly that it has become necessary for them to open a branch house there, and Mr. Walter C. McKinlock is now in St. Louis looking after the interests of the branch house. Mr. W. F. Richardson reports business as excellent. The new National india-rubber wire, for which they are general Western agents, is taking remarkably well with the trade and they have already secured some very nice orders.

Mr. Wm. Hood, No. 239 La Salle street, Chicago, has closed a contract with the Electrical Manufacturing Co. for the exclusive right to sell their incandescent lamps in the States of Illinois, Indiana, Iowa, and Nebraska with the privilege of selling also in the States of Wisconsin, Minnesota, Michigan, Ohio and other Western States. He will carry a large stock of not less than 10,000 lamps always on hand, thus enabling him to fill orders with the greatest promptitude. The name of the lamp is the "Brilliant."

George Cutter is organizing a company for the manufacture of rheostats and electric heaters with the wires imbedded in enamel. The new company expects to build factories both at Chicago and in the East, and will start with a capital of $250,000.

Mr. L. K. Comstock, electrical engineer and contractor, No. 1419 Monadnock Building, is doing a good business in electrical construction work. Mr. Comstock makes plans and specifications for the installation of electrical plants.

Mr. George B. Merrill, manager of the Western department of the Falls Rivet & Machine Co., reports business as excellent in his line and has numerous large contracts for power transmission machinery on hand.

Mr. W. R. Mason, general manager of the Railway Equipment Co., of Chicago, has just returned from a short trip East. He is full of business as usual and consignments are going out to street railroads everwhere.

Mr. Thomas Dillon of Indianapolis was in Chicago last week and a caller at the Western office of the Engineer. He is doing an extensive business in his mast-arms and other specialties.

Clark & Marshall, No. 418 Rookery, Chicago, have received the Western agency for the Premier Electric Co., of Brooklyn. N. Y., for their battery fan motors and other specialties.

T. C. Rafferty, secretary of the Great Western Electric Supply Co., Chicago, Ill., has just returned from a three weeks' trip to the Maine summer resorts, where he had a glorious time.

Mr. R. Humffreys-Roberts, secretary and manager of the Fontaine Crossing Co., Detroit, Mich., spent a few days in Chicago last week on railroad and electrical business.

The Standard Battery Co. are very busy manufacturing the Willoughby iron gravity battery, which was recently described in The Electrical Engineer.

The Central Electric Co. are very busy and are making some exceedingly heavy shipments in Okonite wire and general electrical supplies.

PHILADELPHIA NOTE.

After a very severe contest, the entire electric contract for the Betz Office Building, in Philadelphia, has been awarded to H. Ward Leonard & Co. In this handsome office building there will be between 3,000 and 4,000 lamps, and the plant will be a most modern one in every respect. Dr. W. A. Drysdale is the consulting electrical engineer for the work, and Mr. Alfred Wolff, of New York City, the consulting engineer on the steam work. The plant is to have slow-speed dynamos, directly coupled on the shaft of the engine. The plant, when completed, will be one of the handsomest in the United States.

NEW ENGLAND NOTES.

The Northern Electrical Supply Company, of Concord, N. H., has been organized with the purpose of doing a general electrical supply and construction business in that section of the country. They have to start on a paid-up capital of $5,000; but the directors have already voted to increase that amount to $20,000, and further increase will be made as the business demands. They have at present the agency for Eddy motors in their territory, and are using the Bernstein incandescent lamps. They will also carry a complete line of telegraph instruments, and will form other agencies as soon as they can be arranged. The officers of the company at present are as follows: T. L. Hoitt, president; N. E. Martin, vice-president and treasurer; H. J. Lowell, general agent; W. B. Ross, general manager, and Geo. P. Warde, superintendent.

The Barney Ventilating Fan Company, of Boston, have just installed two 60-inch fans in the dynamo-room of the Congress street station of the Boston Electric Company, for the removal of hot air; one 48-inch fan for the same use in the station of the Fall River Electric Light Company, at Fall River, Mass.; one fan in the station of the Walworth Light and Power Company, Boston, and another in the electric light department of the J. Montgomery Sears estate, in Boston. It is a common thing to find dynamo-rooms extremely hot, and these fans are well calculated to reduce the temperature and keep a cool draught circulating all the time by the removal of hot air.

MONTREAL NOTES.

The Merchants' Telephone Co., of Montreal, has applied for incorporation with a capital of $100,000, to do a general telephone and electric business. The object of this company is to furnish a telephone service at the lowest possible rates by having a co-operative company, with the telephone users as stockholders. The experience in Canada as to other opposition companies is that they are sooner or later absorbed or bought out by the Bell Telephone Company, and in order to prevent this, in the case of the new company, each subscriber for a telephone must also subscribe for $100 of its stock and also agree to take his telephone for a period of five years. The rental of a telephone has been fixed at $25 per annum, and the stock of the company having been fully subscribed, will be increased largely. The incorporators are F. X. Moisan, L. E. Beauchamp, O. Vanier, J. E. MacDougall, J. Archambault and C. F. Beauchemin.

Canadian General Electric Co.—A meeting of the Canadian General Electric Company will be held in Montreal shortly with the object of making arrangements for the consolidation of the Edison and Thomson-Houston interests in Canada. This company was incorporated at the last session of the Canadian Parliament with a capital of $1,000,000, the incorporators being Samuel Insull, M. D. Barr, H. W. Darling, John Langton and H. M. Francis.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XIV. AUGUST 24, 1892. No. 225.

DIVING FOR TREASURE AT HELL GATE.

BY

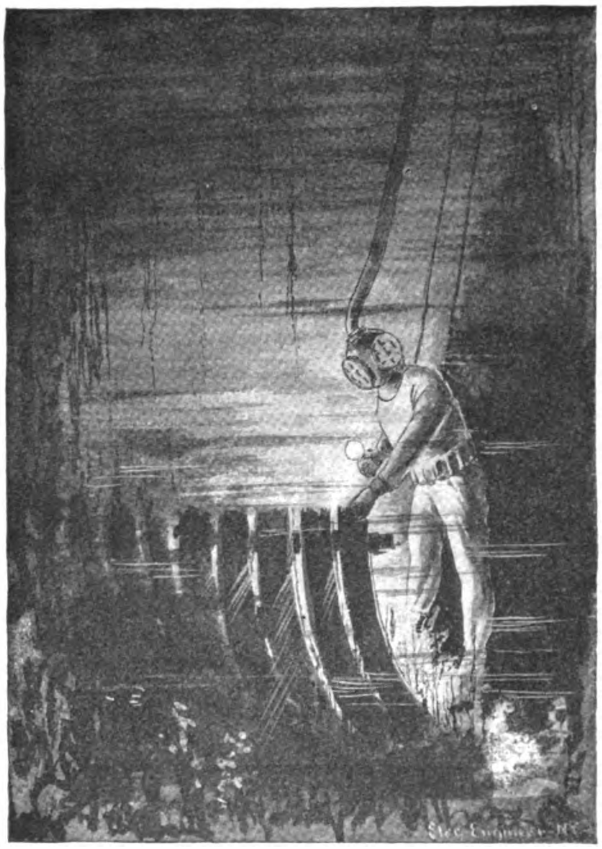
George Barton Muldaur

“*Found!*”

AT THE bottom of Hell Gate, nearly opposite Port Morris, lies all that is left of the British man-of-war, “Hussar,” together with her cargo of $4,800,000 worth of British guineas. The chains that bound seventy American prisoners to the gun deck and dragged them under when the good ship sank one hundred and twelve years ago, are probably there too, but they are empty by this time, and not being made of gold, are of no further interest. The “Hussar,” carrying the pay for the King's troops then massed in the vicinity of New London, failed in an attempt to make the Hell Gate passage, at that time infinitely worse than at present, and went down in deep water near the western, New York shore. She lies at the foot of a sheer precipice, with her hull extending diagonally into the stream, at a point where the water is now 72 feet deep at low tide; and is covered with the accumulated sand, mud, and barnacles of a century.

Several futile attempts have been made to recover the hidden treasure, the most important being that of the Worcester Hussar Wrecking Co., in 1866. By that time the wreck had become so caked with sand and barnacles that explosives were used, and numbers of historic relics, quantities of guns, balls, bullets, and flints, some jewelry and a little money were recovered. The tides and darkness proved too great a handicap, however, and the enterprise was abandoned like the rest.

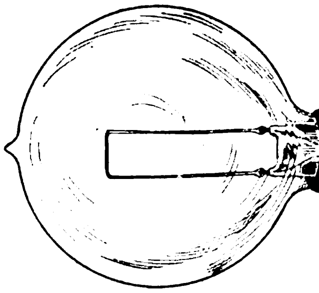
It is more than human nature can readily stand to allow so much wealth to remain long undisturbed only a few rods away. That the distance is vertical, and is more properly measured in fathoms is a mere detail, so that the advent of the Little Giant Hussar Wrecking Company prepared to make another attempt is not surprising. The company was formed by Capt. Thomas Simonds, of Leominster, Mass., whose dredging outfit has already done good service, in New England waters, and contains some points of especial interest. The dredging scow is fully equipped with the machinery usual in such cases. The engine and hoist for the dredge, and the pump operating the hydraulic cylinder which closes and opens it, take up most of the space, but the interest of an electrician is immediately attracted to the opposite end of the scow, where, on a little shelf about 12 x 18 inches in area, stands the dynamo which, more than any other piece of apparatus, gives to the present undertaking an air of novelty. The former attempts at raising the treasure were given up mainly on account of the pitchy darkness at the bottom of the river, even during the strongest daylight above, compelling the divers to work entirely by the sense of touch. But now all this has been changed.



The Electric Light at Twelve Fathoms.

At the opposite end of the scow referred to is stationed the pump used to supply air to the diver when at work. This is run by a small vertical 5 x 7 inch Atlas engine, to the fly-wheel of which is belted the dynamo, a 50-volt machine built by the Colburn Electric Company of Fitchburg, Mass., and having a capacity of eight 25 c. p. lamps. Only one Thomson-Houston 35-volt lamp of 65 c. p. is employed. This has a spherical bulb of especially heavy glass to withstand the pressure of the water, for it is used without the protection of a box, shield or cover of any kind.

When the diver is ready to descend, the small engine is set in motion, starting the air pump and dynamo, and the flexible conductor leading to the lamp is paid out with the air tube as it is needed. The conductor is fastened to the side of the helmet some three feet from the lamp, so that when not in use, or when the diver needs both hands for his work, the lamp is simply let go and floats out of the way above his head like a miniature fire balloon. When he wants it again, it is drawn down by the conductor. The socket is carefully wrapped with rubber tape to protect it from the water. The men are delighted with the simplicity and effectiveness of the arrangement, which enables them to do so much better, quicker and safer work; and it would seem that such an outfit would find general application in comparatively shallow waters, or for wrecking operations of like nature.



Lamp Without Shield or Case Used in Twelve Fathoms of Water.

UNITS AT THE BRITISH ASSOCIATION MEETING AT EDINBURGH, SCOTLAND. AUGUST, 1892.

BY

H. S. Carhart.

The committee of the British Association on electrical standards have had two long meetings at their session, and to these meetings were invited Prof. von Helmholtz, Drs. Lindeck and Kahle, of Berlin; Dr. Guilleaume, of the French Bureau at Sevre, and myself as foreign visitors. The result of these discussions was the following report:

"1. That the resistance of a specified column of mercury be adopted as the practical unit of resistance."

"2. That 14.4521 grammes of mercury in the form of a column of uniform cross-section, 106.3 cm. in height, at 0 degrees C., be the specified column."

"3. That standards in mercury or solid metals, having the same resistance as this column, be made and deposited as standards of resistance for industrial purposes."

"4. That such standards be periodically compared with each other, and also that their values be redetermined at intervals in terms of a freshly set-up mercurial column."

It was further agreed that these resolutions be communicated to the electrical standards committee of the Board of Trade.

With regard to the unit of current and of electromotive force, it was agreed that the number 0.001118 should be adopted as the number of grammes of silver deposited per second from a neutral solution of nitrate of silver by a current of one ampere, and that the value 1.434 should be the electromotive force of Clark cells at 15° C. Prof. von Helmholtz expressed his concurrence in these decisions.

The reason for not expressing the dimensions of the mercurial column in cross-section was the discrepancy between the standard kilogramme and the cubic decimetre of water at 4° C. The investigations in France and Germany show the mercurial standard to be exceedingly reliable as now constructed.

Regarding the Clark cell, the value of the E. M. F. assigned agrees with the value 0.001118 grammes of silver deposited by an ampere per second, when the cell is set up with a saturated solution in a particular specified manner. No recommendations were made as to the form of the Clark cell which is best for practical industrial purposes.

I may add that the comparisons of my own cells made with the standards kept at the Board of Trade electrical bureau by Major Cardew and Mr. Rennie agree with my own assigned value to a very gratifying degree of precision.

THE AURORA BOREALIS.

At Godthaab, in South Greenland, says the London *Electrical Review*, auroræ boreales are, of course, frequently observed phenomena, and from a lengthy series of observations which have been made on them there and elsewhere, A. W. Paulson has recently come to certain important conclusions. In temperate countries the auroræ take place in the higher regions of the air, whilst in the south of Greenland, the region in which they are produced, probably extends from high altitudes to the surface of the ground. Hypothecating, therefore, the electrical origin of the phenomena, it appears that an electric current circulates in low latitudes in the higher regions of the atmosphere, whilst in the zone proper of auroræ boreales, it descends to the surface. Doubtless, too, they are connected with the rarefaction of the air; a great difference in this property being observed in the atmosphere of arctic and temperate regions. At Godthaab, the greatest daily activity of the auroræ is at 9 p. m., and the annual maximum is about the winter solstice; there is a maximum frequency at those periods when the number of sunspots is *smallest*, and conversely. The observations which have been made appear to contradict Trombolt's law, according to which the auroral zone moves in the course of 24 hours, so that it is directed to the north.

A GREAT ELECTRIC BOULEVARD BETWEEN WASHINGTON AND BALTIMORE.

Admiral Ammen's scheme to turn the old turnpike between Washington and Baltimore into a great boulevard and to construct an electric line connecting the two cities has been revived, and there are prospects of its success. The company has its franchises and is organized with $150,000 capital, with authority to increase it to $300,000.

Widener & Elkins, the Philadelphia street car magnates, and their associates, have a controlling interest in the enterprise. The distance is about forty miles, and the expectation is that it will be a succession of suburban towns. The electric road would come into competition with the Baltimore and Ohio.

THE CHICAGO-ST. LOUIS ELECTRIC ROAD.

Work has begun on the construction of the Chicago and St. Louis Electric Railroad at Edinburgh, Christian county, Ill., and the president of the proposed new road says that the building of the road will be pushed, and that it will be in operation in a few months, as most of the right of way has been secured and much preliminary work done. The road, as surveyed, makes a bee line between St. Louis and Chicago. It will be remembered that this is the scheme of Dr. Wellington Adams as recently described by him before the New York Electric Club.

THE MODERN ELECTRIC SEARCH LIGHT.

BY

E. R. Knowles. C. E.

In a former article[1] I have given a general history of the electrical projector or search light from its earliest inception up to the present time, together with a general description of its various form and uses. In the present article I shall endeavor to give a general description of the latest and most improved form of electrical projector.

As with age comes experience and with experience comes a knowledge of the exact fitness of things, so with the electric projector. At first a very simple and crude piece of mechanism, limited in its capacity and application, it has, as time has passed, been more and more perfected and improved, its capacity has been enlarged and expanded, and its applications have become more numerous and widespread until, at the present time, it has passed the experimental stage and has become an instrument of exactness and precision, with vastly enlarged capacities, while its commercial applications have become almost innumerable.

With the experience due to this evolution from the simple to the complex has come the knowledge of the requirements of such an instrument. In general terms the modern electric projector must be capable, among other things, of filling the following conditions: It must be entirely automatic in its operation; controllably operated from a distance or operated by hand if so desired; it must give a parallel beam of light or a variable divergent beam at will as may be desired; it must be capable of revolving the beam of light horizontally in either direction or automatically back and forth over any specified arc of the horizon and also vertically up or down. In addition to this, it must be capable of varying the speed of its movements fast or slow in any direction, or of being moved by small increments of distance step by step in any direction; its lamp or source of light must be either automatic in its operation or hand controlled and capable of quick and easy adjustment; it must be light-tight, that is, no light must escape from the apparatus other than the projected beam, while at the same time it must be well ventilated so that the heat generated by the lamp may not injure the reflecting mirror. Finally, it must be arranged so that the projected beam may be alternately extinguished and made visible or "flashed," for the purpose of signaling.

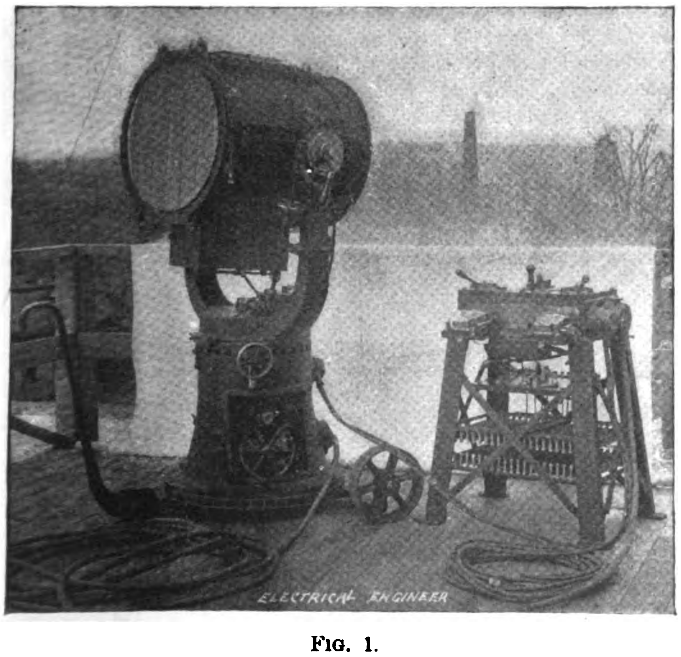


Fig. 1.

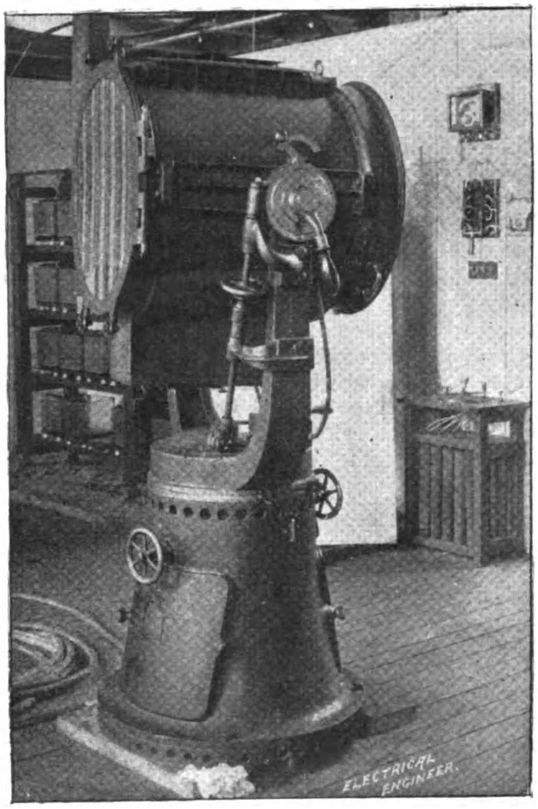


Fig. 2.

The electrical projector to be described, and illustrated in the accompanying engravings, was designed to meet these varied requirements. In Fig. 1 is shown the complete instrument, together with its control stand and electrical connections. The projector is also shown enlarged in Fig. 2, and the control stand in Fig. 3. It will be seen from the illustration, Fig. 2, that the projector is composed of three principal parts, viz., a drum suspended on trunnions at the top of a fork, which is in turn supported by a base or pedestal. The drum is made of sheet metal reinforced at each end by metal rings and strengthened along the side by girders which carry the supporting trunnions; this drum carries at one end the reflecting mirror, which in these instruments is of glass of the Mangin type, and at the other end a pair of doors, one hinged to the drum and the other capable of moving back and forth horizontally across the face of the fixed door. These two doors are each provided with a set of strip lenses, so arranged that when the movable door is at one end of its path the two sets of lenses act together to render the emergent beam of light sensibly parallel, and when at the other end the two sets of lenses act together to cause the beam of light to be spread out at a maximum angle of divergence, the angle of divergence of the beam being any desired amount between these two limits according to the relative positions of the two sets of lenses.

The top and bottom of the drum are perforated and covered by shields so arranged as to permit the entrance and egress of air but preventing the escape of light from the interior of the drum. At the bottom of the drum is provided a box in which the mechanism of the electric lamp is placed when it is in operation; this box is provided with suitable mechanism for adjusting the position of the lamp along the axis of the drum in order to bring the luminous arc into the focus of the reflecting mirror. Inside the drum a movable shield is placed in such a position that by means of a lever on the outside of the drum it can be lowered when desired, so as to cover up the luminous arc of the lamp and so shut off all light from the reflecting mirror. By giving this shield a back-and-forth movement, the light can be alternately shown and extinguished or flashed according to any set of preconcerted signals.

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[1] See The Electrical Engineer, July 27 and August 3.

The drum is arranged to revolve vertically in bearings at the top of a fork which is pivoted to, and is capable of revolving horizontally upon, a supporting base or pedestal. Attached to one of the trunnions of the drum is suitable gearing, which passes down the side of the fork and through its base into the interior of the supporting pedestal, where it is connected to an electric motor and controlling device situated therein, which is shown in Fig. 5. This gearing is so arranged that it can either be operated by this electric control, or can be operated by hand independently, by means of suitably arranged hand wheels.

On the outer surface of the base of the fork are placed two adjustable stops, which, by the horizontal rotation of the fork, are brought into contact with and move a switch lever upon the outside of the pedestal, which acts to automatically reverse the operating of the electric control motor, and so automatically reverses the direction of the horizontal motion of the fork. These stops can be placed in any desired position so that the fork, and with it the drum, can be caused to move horizontally back and forth through any desired angle. The motor and electrical control is so arranged that it may be revolved in either direction and by means of the gearing provided, it can move the drum up or down in a vertical direction and the fork carrying the drum horizontally in either direction. The electric lamp is shown in Fig. 4, and is so arranged that it is perfectly automatic in its operation, feeding both carbons together as they consume a proportionate amount so as to maintain the luminous arc at a fixed point, or is so arranged that it may be operated and the carbons moved by hand.

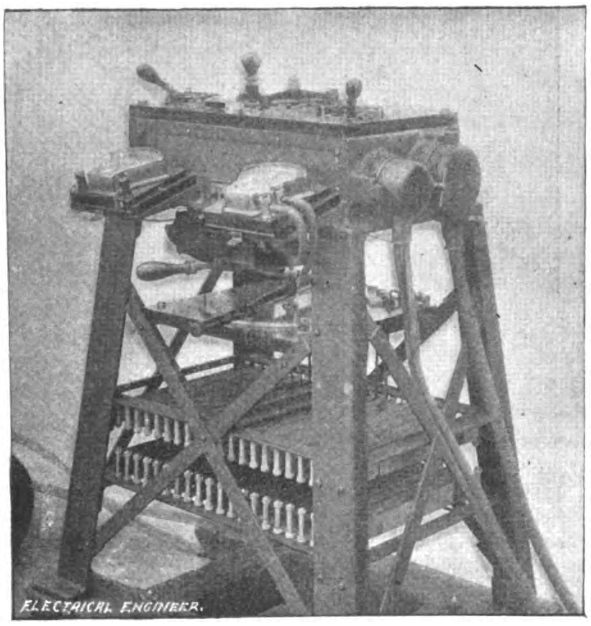


Fig. 3.

In Fig. 3 is shown the control stand, which is connected to the source of supply of the electric current and to the projector by suitable wires, and which may be situated at any distance desired from the projector. It is provided with a switch and adjustable rheostat for controlling the electric lamp, with a switch and adjustable rheostat for controlling the electric control motor, and with switches for controlling the vertical movements of the drum and the horizontal movements of the fork, and also with a switch for giving a step-by-step or slow movment in any desired direction, It is also provided with a voltmeter and ammeter for indicating the pressure of the circuit and at the terminals of the electric lamp and the current which is flowing through the apparatus. By means of this control stand, all of the required movements described may be accomplished and the electrical projector be always under control, no matter how far away it may be placed.

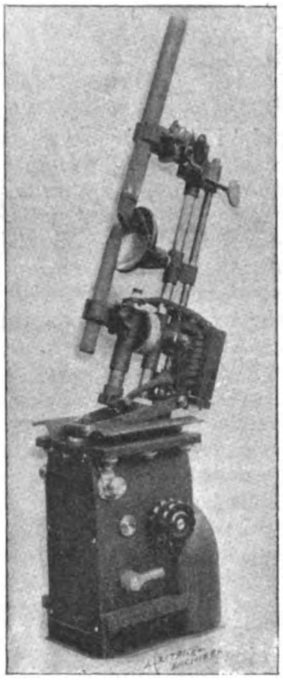


Fig 4.

These projectors are now built in various sizes, according to the diameters of the reflecting mirrors, either electrically or hand controlled, singly or together, and are provided with fixed or variable divergence to the beam or with only the non-divergent beam, as may be desired. They are solidly and durably built, of compact yet graceful form and design, and are believed to embody all the most recent improvements and as being the most powerful instruments now in use. From recent tests it is found that the 24-inch instrument is capable, on a dark night,

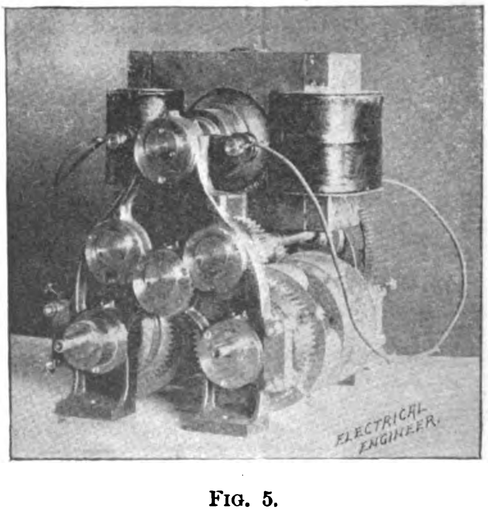


Fig. 5.

of picking up a light-colored target at a distance of 15,000 feet, the other instruments being in like proportion. Fig. 6 shows the appearance of one of these projectors when in operation. The illustration is from a photograph taken at night, and graphically depicts the appearance of the projector and its beam of light and an object in the distance which is illuminated by the projected beam.

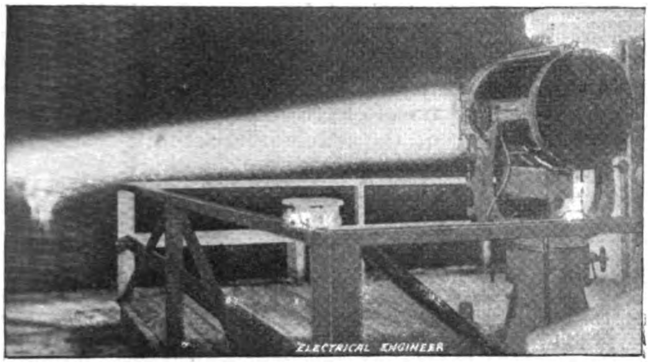


FIG. 6.

THE CENTRAL STATION OF THE CONCORD GAS LIGHT COMPANY AT CONCORD, N. H.

BY

A. C. Shaw.

MUCH interest has of late been shown in the new station of the Concord Gaslight Company, at Concord, N. H., owing to the fact of its being the first central station in this vicinity in which all the dynamos are driven by the "L. P. and D.," transmitters manufactured by Perry and Demeritt, of Montpelier, Vt. The Concord Gaslight Company commenced business about six years ago with about 15 Thomson-Houston arc lights in a small basement, and increased by gradual stages, in much the same way as other New England central stations that I have described in these columns, until they had about a year ago four Thomson-Houston 50-light arc dynamos in full service. As the business kept increasing, and the demand for incandescent light became pressing, a new station was rendered necessary, where economical power could be procured, and where the capacity could be increased when required.

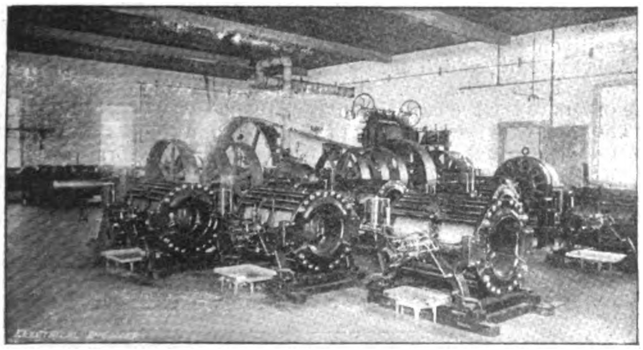


FIG. 1.—CONCORD CENTRAL STATION.

The site of the station is about 500 feet from the Merrimac River, though, unfortunately, owing to the water being impregnated with a fine sand, it is impossible to pump it for condensing purposes. The boiler-room is 45 feet by 32 feet, one story high, and contains two three-sheet steel boilers 72 inches diameter by 16 feet long, manufactured by the Bigelow Company of New Haven, and fitted with Sydney Smith setting. In the boiler-room also are a 300 h. p. Jacobs feed-water heater and a Spencer damper regulator. The engine-room is 45 feet by 65 feet, and is one story and a half high, the upper room being used as a storeroom. The engine is of the Reynolds-Corliss high pressure type, built by E. P. Allis & Co. of Milwaukee, Wis., with single cylinder 18x42 inches, making 84 revolutions per minute, and working at 100 pounds pressure. The fly-wheel is 12 feet in diameter, with a 27-inch face, and belts direct onto the countershaft, which runs across the entire length of the room, the belt running under a belt tightener manufactured by the Holyoke Machine Company, of Worcester. The shafting is 5 inches in diameter, with a 54-inch driving pulley on the engine end, and having one Hunter friction clutch in the middle of the shaft. The whole was supplied by H. N. Bates & Company, of Boston. The section of the shaft nearest to the engine carries three 54-inch pulleys with 9-inch face, which drive three 50-light Thomson-Houston arc dynamos used for the city lighting. On this section also is a 72-inch pulley with a 13-inch face driving a 1,350 light Thomson-Houston alternating incandescent dynamo at a speed of 1,070 revolutions per minute. The other section of the shaft also carries three 54-inch pulleys which drive three 50-light Thomson-Houston arc dynamos for commercial lighting.

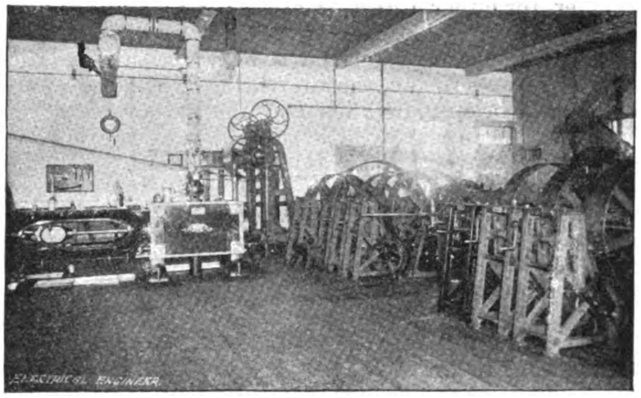


FIG. 2.—CONCORD CENTRAL STATION.

As the "L. P. and D." system is quite novel for central station work, and one of the strongest claims which can be made for it is the saving in floor space, a few details as to the dimensions of the area occupied by the shafting, dynamos and transmitters will be found interesting. The three pulleys are set on the shaft 22 inches apart, measuring from the centres of the face. The dynamos are arranged one behind the other, as shown in Fig. 1, their centre lines being also 22 inches from each other. The distance from the centre of the shaft to the centre of the pulley of the nearest dynamo is 4 feet 8 inches, and the one dynamo stands 5 feet 6 inches behind the other, measuring between the pulley centres.

Leaving out of consideration the incandescent dynamo, as it is an odd feature in the arrangement, the six arc machines are thus arranged in two groups of three, each group being driven from different sections of the shaft. Each group of three dynamos stands in an area measuring 15 feet by 7 feet, and the six dynamos occupy an area of 15 feet by 21 feet 3 inches. The six dynamos, together with the shafting, clutches, floor stands, and six "L. P. & D." transmitters, the details of which have already been described in THE ELECTRICAL ENGINEER, occupy a space of only

22 feet 4 inches, by 21 feet 3 inches. Each dynamo is driven by a separate transmitter so that it can be started or stopped at will, not interfering in the least with the action of the others. The station has been running since March of this year, and this system of driving has given perfect satisfaction, and is greatly appreciated by the electrician and engineer, there being perfect regularity in the speed and no slip. When the alternator is started and the potential determined, the speed is so steady that it is unnecessary to touch the rheostat again for the rest of the evening. An 8½ inch belt is used for transmitting the power to the arc dynamos, and a 12½ inch belt for the alternating dynamo.

The arc light switchboard, built by the Wright Electical Engineering Company, of Boston, is made of slate and iron, divided into two horizontal sections. The top section is fitted with lightning arresters, below which is a row of spring jacks on each side of the circuit, so arranged that the lightest circuit can be arranged for lighting the station. On the lower section are the machine terminals, the wires to which are all carried on porcelain insulators below the floor. The station is wired throughout with Okonite, as much as three miles of wire being used. The alternating switchboard is of the skeleton type, made of ash, filled and varnished, and fitted with four double-pole double-throw switches, for use when two dynamos are in service, to prevent the current from the one entering the other. The board is long enough for two machines and is fitted with the usual Thomson-Houston current indicators and voltmeters, in addition to which a standard Weston voltmeter for either direct or alternating circuits is used.

The building is of brick with Concord granite foundations. The engine stands on a heavy brick foundation with granite underneath, the alternating dynamo being also situated on a brick foundation and the anchor bolts held down by cast iron plates. The shafting runs on brick piers with iron plates resting on granite foundations. The floor is of Georgia pine oiled, resting on hard pine stringers. The roof is of wood covered with tin and slate, and is of the same construction both in the engine and boiler rooms. On the roof of the boiler-room is a steam whistle, with an eight-inch gong attached to a two-inch steam pipe, for calling the attention of the lamp trimmers when required, who respond by going to the nearest telephone. The trimmer who attends to the lamps is provided with a safety bicycle, fitted with a leather bag for carrying the carbons. All carbons taken from the lamps are taken back to the station and the short lengths jointed together by the M. P. Stevens patented process and used again in the lamps.

The Concord Gas Light Company was incororporated in 1852, and has now a capital of $125,000. The Hon. John Kimball is president and treasurer of the company and W. A. Richmond, superintendent and electrician, all of the electrical work having been designed by him and carried out under his instructions.

SENSITIVE WATERFALLS.

BY

Edwin J. Houston

I HAVE been much interested in a note by Prof. W. B. Croft in *Nature*, quoted in the issue of THE ELECTRICAL ENGINEER of July 27. In this note reference is made to the phenomenon of a water jet that responded to the running of a small Wimshurst electrostatic induction machine at a distance of some 13 feet.

Unfortunately I am out of the city at present and having no access to Prof. Croft's note, cannot intelligently discuss the conditions of the problem. Timed electrostatic discharges could readily cause the disturbances referred to and so also could a musical note of a definite pitch. I do not exactly understand the reference to similar phenomena being produced by the presence of the electrified rod, unless it is a phase of Faraday's experiment with a liquid jet.

I make this brief communication, however, for the purpose of referring to some observation made by me in 1872, and published in the *Journal of the Franklin Institute* for October, 1872. These experiments would appear to show that the phenomena referred to by Prof. Croft might have been caused by sympathetic sound-waves; or, as I have already hinted, by timed electrostatic discharges.

Below is a copy of the article referred to:

A SENSITIVE WATERFALL.

By Prof. Edwin J. Houston.

The recent developments of acoustics have been rich in their revelation of the wide-spread influence exerted by sound-waves, in shaping and moulding matter when in a condition to easily allow the movement of its particles. The eye as well as the ear can now be appealed to to detect the presence of these invisible waves. At their touch, light sand strewn over tense membranes is heaped up in miniature hills, with even greater precision and regularity than by the grosser waves by the seashore, the number and order of the hills, together with the relative size of their interlying valleys, not only witnessing the work of the sound-waves, but also indicating their exact nature and number. Water jets, gas jets, smoke jets and flames of most all gases are also, under favorable circumstances, likewise affected, changing their shape, size, duration and general appearance in the most curious manner. So delicate, indeed, are some of these methods, that waves too feeble to allow of translation by the ear into sound are instantly appreciated by the eye as motion.

There are many different ways in which sound-waves can thus reveal their presence to the eye; we have sensitive flames, both covered and naked, smoky and clear, silent and noisy; we have sensitive jets of gas, water and smoke, and many other instances of this kind of sensitiveness that will recur to the student of physics. I propose to add another, of quite a novel character to the already lengthened list.

While spending a summer's vacation in Pike County, Pa., I had the good fortune to discover the sensitiveness of water to sound-waves on a large scale. Among the many beautiful waterfalls in this portion of our State I visited one in which a scanty supply of water was dripping from the moss-covered walls of a precipice. Each stream poured from the end of a pendant of moss, formed generally of one or two tiny leaflets. The air was unusually still, and the streams presented for some distance a vein remarkably free from ventral segments. Struck by this circumstance, it occurred to me to try the sensitiveness of these streams to the notes of the voice, and after several attempts I found a tone, a shrill falsetto, to which they would respond. On sounding this note the grouping of the drops and the positions of the ventral segments were instantly changed. As the streams were of different diameter, they were not all sensitive to the same note; but at one portion of the falls, from which about one hundred of these thin, delicate streams were dripping, a very large number of them responded. A friend who was with me, a gentleman of nice powers of observation, witnessed the same phenomenon.

I was unable to determine the exact conditions of success, but am satisfied that they are not easily obtained, as at several other falls, where the streams appeared nearly of the same character, none were found that would respond to the voice, although a variety of different tones were tried. At one falls, however, a number of streams were found that were almost equal to the first in sensitiveness.

A heavy rain, which flooded the stream, prevented me from renewing the observation. The publication of the facts will enable others to try the experiments for themselves.

The change in the grouping of the drops and the position of the ventral segments is, no doubt, to be ascribed to a vibration communicated by the sound-waves to the delicate filaments of moss from which the water flows. These act somewhat in the manner of reeds, and simulate the orifice of the ordinary sensitive jet, by whose vibrations the appearance of the issuing stream is altered.

The falls at which the observation was first made are situated on Adams' Brook, near Dingman's Ferry, about two and one-half miles up stream from the stage road leading to Milford, Pa.

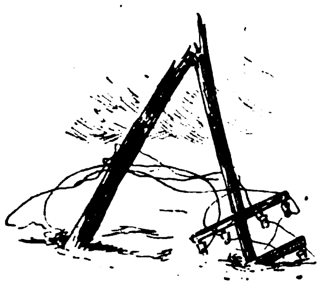
ELECTRICITY AND PROGRESS.

OUR CORRESPONDENT at Troy, N. Y., writes us: "It is constantly impressed upon every one here that the motor cars passing through a neighborhood, have the peculiar affect of brightening up the surrounding property by causing houses to be repainted, sidewalks relaid, and what might be called putting a new face on the whole matter. Great is progress; and electricity is at the bottom of it."

PERMANENCY AN IMPORTANT FACTOR IN ELECTRICAL WORK.

BY

Geo. Harris



A WORD that the writer would strike out of the language forever, so far as it relates to electrical work, is that often-used one, "Temporary." Where is there among the vast army of electrical workers one who has not heard this and kindred expressions, "Never mind, its only temporary" and "We can't afford to spend much time or money as it is only temporary" and who is there that has not seen the resultant disastrous effects of such blindness to the real truth? The synonym of "temporary" should be carelessness, incompetency and consequent loss, as they are the causes that lead to such a careless disregard of all the well-established rules of good workmanship.

It has been my good fortune to visit three-fourths of the various countries on this globe always taking an active interest in the many fields of applied electricity. I have been a close observer, but I am not alone in it; others have noticed it like myself and have commented on the only too general lack, chiefly in America, of the stability and the permanency which should be *the* important factors in electrical installations of whatever character. True, there is a gradual awakening on these lines and with the advent of the electrical engineer comes safe, permanent work in every department.

Up to within a short time, no class of electrical workers were more prone to substitute temporary work for that which should be permanent than telephone employees. This was caused in part by the ever-shifting character of the work, and the army of men that was necessarily employed, who happily have been weeded out until only the bright members of the flock remain. Troubles were of a consequence in the ascendency and the sole object of every man was to remove them, no matter if they did come in again a few days afterwards. The ways for clearing trouble were many and varied. If the line was grounded and the trouble was found to be caused by the wire dropping down on an awning or iron front, how easy it was to tighten it by taking a few turns around the insulator, or worse still by crimping it zigzag fashion with your pliers. Of course if the manager discovered it (and he rarely did so) your excuse was, "That it was only temporary," or that you had fogotten your vise and strap or that the line would have to be changed. The next man that came along knocked the wire off the insulator or else the strain gradually straightened out the kinks until the same old "ground" came in again, only to be repaired in the same manner. If your line was found open, how much easier (!) it was to cut in a new line and change it in the exchange than it was to trace out the trouble and fix it. Of course you didn't intend to leave it that way. As soon as you got the chance you would hunt it. *The time never came.* If the gas meter was taken away from the building leaving the line open, the quickest way to close it was to connect the pipes together temporarily until you could run a new "ground" to the street pipe. The new ground was never run unless the thing got tired of working through red lead joints and kicked; and then it had to be put in good shape. If you found that the transmitter battery had given out in disgust and actually eaten itself up through want of attention, you were dismayed to find that you had forgotten to bring an extra zinc with you, but by filling the jar full and pushing the zinc farther down you would be able to talk and be satisfied in your own mind that it was all right. You would come by there "to-morrow" and put in a new zinc. The "to-morrow" is still coming. If the cord was broken it was *so* easy to use a couple of pieces of office wire until a new cord could be procured—generally several days afterwards, and not perhaps even then, unless the subscriber "kicked" or the wires broke off. Then you would remember your former visit and go loaded.

These are not exaggerated cases, as any man that has been any length of time in the telephone business knows. You fully intended to go back and fix things up as they should be, but somehow or other you never got the chance to go.

Though I have not been actively engaged in telephone work in some time, except at intervals, I have kept myself familiar with its progress and I am glad to note a general tendency towards permanent work both inside and out. The advent of the Long-Distance Telephone and the splendid construction of that company has done much to stimulate matters in this direction, together with the fact that the companies themselves have begun to see the necessity of keeping the "Maintenance Account" within the rental account at least. With many companies it exceeded the receipts. The multitude of inventions in this direction has done away with many troubles, and their consequent removals have been reduced to a minimum.

With something like the ardor of the moth attracted to the candle, the army of employees of the electric lighting companies were recruited from the telephone companies, and the same methods were carried out until the height of bad workmanship was reached.

In electric lighting the necessity for *permanency* is even a greater factor than in telephony. With valuable property at the mercy of every installation contained therein, permanency and safety go hand in hand. Electrical engineering has made wonderful strides in this direction as well as in every other, as safe and permanent work is good engineering, no matter in what direction it tends; but there is yet an immense amount of progress to be made before perfection will be reached, if ever. How many stations we find that are actually a disgrace to the profession, if the persons in charge can be classed as being members of the profession. The sole object of such stations, or more properly speaking of those in charge, seems to be the grinding out of current and the collection of the bills, and the manner in which the former is accomplished would cause a good station manager to hold up his hands in holy horror. Every element of safety, permanency and good workmanship is cast to the four winds. Wires run in all directions, switchboards and their expensive apparatus are exposed to leaking sky lights or roofs; no other flooring but Mother Earth, no protection to employees, etc. I have in my mind one station not far from Dallas, Tex., that was operated under just such conditions as these until as a natural result it depreciated itself and was sold out under a deed of trust bringing scarcely the original price of any one of the dynamos. No fault could be found with the apparatus. It was simply the manner in which it was installed and afterwards maintained. The plant consisted of six arc and one incandescent dynamo, with two street arc circuits, two commercial arc circuits and the incandescent circuit. At first each circuit had its particular dynamo, but as the plant grew and changes became necessary, some one conceived the brilliant idea that all of the arc dynamos could be run in series—a very wise plan but one needing perfect insulation throughout the entire installation. A switchboard of wood was constructed and equipped with a number of single-strap arc switches, so connected that various portions of the circuits could be cut off as lights were turned off. This worked surprisingly well, but with this current of about 4,000 volts and 20 amperes there was fun. Was everything perfectly insulated and carefully handled? By no means. The switchboard was placed directly beneath a skylight, which was always left open for ventilation, and, as a result, the board was drenched every rainstorm. It was built of white pine. It soon became thoroughly soaked. It was wired up with Underwriters' wire, insulated with *soft-rubber tubing!* A pleasing combination. Did any accidents occur therefrom the reader will ask? No, none serious, but they were only prevented by enclosing the board with a railing and throwing all of the responsibility upon one man, the engineer, who was also dynamo man, and fireman as well, at times. But he was one of those rare beings whom an all-wise Providence watches over. After receiving several doses of the *fluid*, he, forever afterwards, threw those switches with about 18 inches of good insulation between them, composed of a water gauge glass, *well dried.* But there were displays of the electric arc in its native state that were beautiful to behold. There were 12 switches to throw, and, consequently, more combinations than a bank vault lock ever dared have. If he forgot the combinations or broke his glass before all the switches were over it was all right. Flying belts, arcs running up or down the switchboard, burning armatures, etc., had no terrors for him. He smiled, Nero like, through it all, and straightened things out as soon as he got around to them. That he was not killed was because he was reserved for a better or worse fate, as he has since become an inmate of one of the State penitentiaries.

The same state of things was prevalent throughout the whole system with its Underwriter's wire, poor porcelain knobs, soft-rubber tubing, and the various other elements of danger. The result was only too well assured. Eighteen fires were caused during the existence of the plant, fires that were traced directly to poor insulation, some of the arc circuits being of *paraffined cotton-covered wire* and cleated at that.

What is true of the plant in question is true of many plants in operation to-day throughout the country, both arc and incandescent. Arc loops left hanging with simply the ends twisted together; wires left hanging loosely on top of lamps; loose connections in hanger-boards and switches, etc., are common. It seems to be the sole object in life of some electric light workman to use any means possible but the right ones to keep the lights burning well, at the cost of safety to themselves, the company's interests and the property that is unfortunute enough to be at their mercy. I know of one case in particular where a lineman sent to remove the lamp closed the circuit (22 amperes) with a piece of No. 14 B. & S. *office wire* and allowed it to remain so for weeks simply because it was too much trouble to close up the loop in a proper manner; and he *expected* that the lamp would be put in again in a *few* days. It was not put in for some weeks, and when found the wire was thoroughly annealed and the insulation charred. Strange to say he was not discharged. As in arc work, so is it in incandescent and motor work. Numerous cases have come under my observation that were equally as "temporary" and unsafe in their character. The substitution of copper wire and in some cases iron baling wire (fact) for an overloaded fuse that persisted in blowing is a pernicious habit but one that is indulged in to an alarming extent. The connecting up of circuits around the fuse; the absence of fuses entirely; the overloading of circuits; the removing of "grounds," or short circuits by *burning* them off as is often done, and a thousand other subterfuges for the "temporary" removal of troubles, are noted methods that in the end only increase the same troubles and add others to the general confusion.

Any electrical workman who has the habit of repairing any defect in a "*temporary*" manner should be forever black-listed.

Are matters being remedied? Yes, to a great extent by the employment of competent electrical engineers for the construction of the plants and their subsequent management if possible. But if not, the management of the electrical department should be given over to a first-class man of known ability and a competent force of assistants. To him and him only should be intrusted the maintenance of the life-producing part of the concern. But it is a well-known fact that in spite of all the knowledge obtainable on the subject and all the free advice given, the management of one half of the plants throughout the country is vested in either a favorite relative without the least knowledge of the subject-matter, or what is worse still, in the local amateur electrician. Owners of electric plants wonder why insurance companies are loath to take the risk even at a higher premium. Can *they* wonder when the insurance inspectors with a far-seeing eye to such matters readily recognize the gross incompetency of those in charge and their utter inability to bring order out of chaos. Who *can* blame them? I am glad to see an earnest disposition on the part of all the well-known manufacturers of electrical apparatus to *insist* on the installation of their apparatus in a first-class, workmanlike and consequently *safe* manner either by their own trusted engineers or other equally competent. Such a disposition cannot fail to show its effects in a short time, and with the earnest co-operation on the part of manufacturers, engineers, owners and employees, no one need blush for shame when it is known whose apparatus is installed, who installed it, and who owns and manages it. Let the word "temporary" be forever banished from the electrical dictionary of every electrical worker, and be banned by every conscientious and painstaking member of the fraternity. Let it be relegated to the past, that unhappy past so fraught with vicissitudes and disasters, and strewn with the wrecks of incompetency, carelessness, and "temporary work."

ELECTRIC STORM PHENOMENA.

BY

W. Finn

THE magnetic storm which occurred on Friday, August 12th, was even more remarkable in point of intensity and for the wide range of territory disturbed than that of its immediate predecessor of July 16th last. It differed from the previous disturbance in being of shorter duration, but in other respects there were many points of similarity observed.

It was about 12.30 p. m. that the storm struck the wires with force enough to overpower the regular working currents, though premonitory warnings of its approach had been noted both on cable and aerial lines for several hours previous, as was the case on the former occasion. The storm had practically disappeared by 5 p. m., but during the interval it succeeded in prostrating more circuits at any given time than has been noticed on any previous occasion.

The height of the disturbance was apparently between 1.45 p. m. and 2.01 p. m., during which time a record was secured of some of the highest values of both pressure and current strength ever noted. These were obtained on wires between New York and Buffalo, the measurements being made from each end of the wires.

Although the area of maximum intensity was found between those two points, the singular fact was noticed, that one of the New York-Chicago circuits via Buffalo, over the Delaware, Lackawanna and Western Railroad was comparatively free from interruption during the whole of the disturbance. The explanation of the anomaly is probably to be found in the assumption that the route of this particular wire formed part of an equipotential surface over which, of course, no natural currents would flow.

Some earth current values taken by means of a tangent galvanometer at the New York end of a Buffalo wire measuring 2,280 ohms are as follows:

Time of observation.	Current strength.	E. M. F. developed.
1.46 p. m.	52.8 milliamperes.	120.3 volts.
1.47 "	285.4 "	650.7 "
1.48 "	281.5 "	641.8 "
1.49 "	29.3 "	66.8 "
1.50 "	91.9 "	209.5 "
1.51 "	2.1 "	4.7 "
1.52 "	20.6 "	45.9 "
1.53 "	31.5 "	71.8 "
1.54 "	80.0 "	182.4 "
1.55 "	264.0 "	601.9 "

The following are some milliammeter measurements taken in Buffalo over another New York wire measuring 3,200 ohms.

Time of observation.	Current strength.	E. M. F. developed.
1.40 p m.	190 milliamperes.	608 volts.
1.47 "	100 "	320 "
1.57 "	80 "	256 "
1.58 "	90 "	288 "
1.59 "	95 "	304 "
2.01 "	240 "	768 "
2.01½ "	105 "	336 "
2.05 "	55 "	176 "
2.05½ "	70 "	224 "
2.06 "	50 "	160 "
2.06½ "	110 "	352 "
2.07 "	70 "	224 "

Other observations taken in Buffalo at 2.30 p. m, over a wire between New York and Chicago, show a difference of potential of 297 volts on the western section, and 352 volts on the eastern section of the wire. Mr. Frank Kitton, the careful and accomplished electrician who made the above tests, remarked this distinction in every measurement taken, although the western section is the longer of the two.

He also noted the following curious effects upon two parallel wires, one terminating in Cleveland and the other in Chicago over which simultaneous observations were made at 2.15 p. m:

Chicago........	+ 50	+ 25	+ 75	+ 90
Cleveland.......	0	— 25	+ 25	+ 40

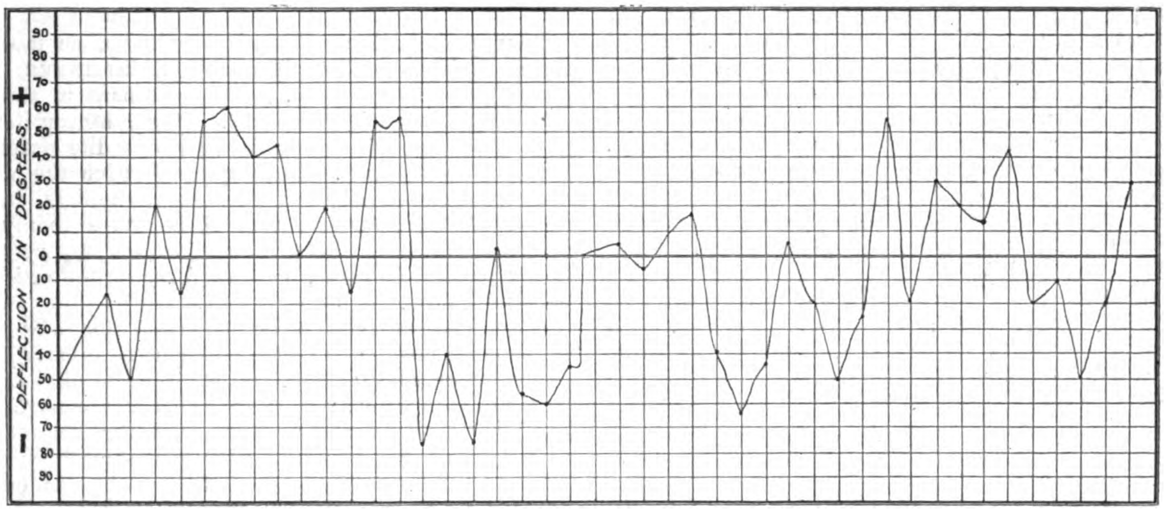
that is to say, a difference of 50 degrees was found to exist every time between the two sets of deflections.

An unusual circumstance connected with the recent storm consists in the fact that the forces completely changed their direction about 2.20 p. m. from the usual easterly and westerly line of flow to that of north and south, so that while circuits running in the latter direction were generally prostrated, those running at right angles could be operated with more or less success. Similar results were noted at Chicago and Richmond, Va., both of which points made tests about that time on some wires extending north and south, and which showed a range in the electromotive forces of from 50 to 340 volts.

Advices from all sources generally agree as to the time of commencement and cessation of the storm, and the characteristics of the earth currents as described by many of the observers correspond as a rule with the observations of the writer.

Some idea of the fluctuating value and reversibility of the current may be gathered from the accompanying illustration, which is a graphical representation of some readings taken on a tangent galvanometer over a Western wire between 1.49 p. m. and 1.54 p. m. The galvanometer has a "constant" of 24 degrees and was provided with a $\frac{1}{10}$ shunt so that the deflections shown, really represent but a tenth part of the actual current strength, the maximum value of which is as tan. 24 degrees: tan. 75 degrees or

$$\frac{3.732}{.4452} \times 10 = 83.8 \text{ milliamperes.}$$



Observations of Earth Current Fluctuations on a New York-Buffalo Circuit During the Electric Storm of August 12.—1.49 to 1.54 p. m.

The undulatory character of the current is quite apparent in the reproduction, from which it is possible to form a conception of the length of the waves during the time of observation.

The distances between the vertical lines do not however represent equal divisions of time in this case, but rather the beginning and end of the different electrical impulses, some of which were long and gradual in their motions, while others were either the very reverse, or of some intermediate grade.

The most interesting and important point associated with the recent storm is the evident relation it bears to the sun spot discovered July 16, which has been credited with all the trouble and inconvenience produced on telegraph lines on that day, besides being saddled with the responsibility for the more serious consequences arising from volcanic, seismic, meteorologic and other disturbances.

The period of revolution of the sun on its axis is about 27 days, which is just the interval that has elapsed since the previous magnetic storm, from which it may be reasonably inferred that the same sun spot was concerned in the production of both phenomena.

It is the first time, however within the experience or knowledge of the writer that the magnitude of the original forces has ever been surpassed by the recurrent phenomena, which have heretofore been either much less intense or altogether without effect upon the practical working of circuits.

WHAT SHOULD BE OUR FUNDAMENTAL UNITS?[1]

BY

Brown Ayres

Our modern systems of units are based upon the assumption of three fundamental quantities, a unit of length, one of mass, and one of time, and on these our whole system of measurement is built up. This is satisfactory as far as it goes, but there are some philosophical objections to it that are worth considering. We have a conception, that of energy, that is daily playing a larger and larger part in our physical reasoning, and the assumption is made that energy is an entity, indestructible and uncreatable in the ordinary processes of nature. Its *reality* is assumed as positive. Yet the best definition that we seem able to give of it is "the capacity to do work." To the question "What is work?" our answer is "the overcoming of resistance through distance," or "the product of a force into distance." And force? "That which applied to mass in time produces motion." And motion involves space and time, and in the sense here used, mass. In this way this real entity, more real to us than matter, as many claim, is only expressible and measurable in terms of units the very nature of which are in dispute. Would it not be better to take for one of the fundamental units a definite quantity of energy, say that liberated as heat by the combustion of so many atoms of carbon in burning to CO_2, and work backwards to our notions of force, and mass, or space, or time. In the language of the mathematicians, we have four related quantities, and the laws of their connection are such that three are sufficient to express all known conditions. The question is, then, which shall we choose?

The present system, under which we choose mass, space and time as fundamental, lends itself to the perpetuation of many confusions and complexities of expressions. For example, there is great confusion in the use of the word "force," it being continually confused with "stress," with which it is connected as weight is with mass, but between which there is no absolutely necessary numerical relationship, aside from experiment. If energy were a unit, the dyne (or the corresponding unit) would be defined as that rate of energy transference or transformation under which one erg (or the corresponding unit) would be transferred per unit space passed through. That is

$$\frac{dE}{ds} = \frac{d(\frac{1}{2}mv^2)}{ds} = m\frac{d^2s}{dt^2} = F$$

When there was no space moved through, or when the velocity was uniform, there would be no added energy and hence no force, although the pull or push—the stress—would continue. The notion we associate with the word stress is not that of a stress but of a force, that is of the rate of energy transformation in the tissues of the muscles, since it is by this only are we able to exert a stress on our tendons and hence resist a stress from, say, the attraction of the earth. The nature of a stress is unknown, and in the nature of the case it is unthinkable. It cannot be expressed in any absolute system, except by identifiction with the force to which it would give rise if motion were to take place. The use of energy as one unit would make the distinction clear and simplify the expression of many physical laws, notably the laws of motion. With energy as a unit, force would be defined as the space rate of variation of energy, power (or activity) as the time rate of variation of energy, and mass would be treated simply as the constant necessary to be introduced to make the laws of kinematics applicable to the motions of actual nature. A change of this kind would involve changes in the definition of many derived units, but it would be worth the trouble. The theory of the potential is a partial realization of the idea here suggested and will serve to give some notion of the improvement that would result.

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[1] Read before the Physical Section of the American Association for the Advancement of Science, at the Washington meeting, August, 1891.

A REPLY TO ENGLISH REMARKS ON RAILWAY POWER PLANTS.

BY

Wm Lee Church

I am glad to have attention called once more to my recent articles in The Electrical Engineer on power plants for electric roads, by the comment in the London *Electrical Review*[1] of July 22. It is a strong item in the general scheme of better intelligence on the practical subject of power plants. I can quite forgive the writer for his good-natured slant at past short-comings, in view of the excellent endorsement which he gives to my general recommendations. I shall ask space for a very brief running comment on same, lest the force of the article should be misdirected.

The *Review* needs to be instructed that a high rate of water consumption is now no longer an invariable accompaniment of a light load, and his remark that under fluctuating loads the "average rate of steam consumption per horse power is necessarily high and the boilers must be proportioned to give steam for this same high rate," no longer applies. As a matter of fact, the non-condensing compound engine will cover its entire range of power at an expenditure of steam lying between 23 and 29 pounds; the latter of course for the light loads. Heretofore the range would be from 26 to anywhere between 40 to 50 pounds, which fact only being known to the *Review*, leads to the remark above quoted. This point has been fully considered in my recommendations of the proportion of 60 h. p. of boilers to 100 h. p. of generators in a railway station, and it will be found that the 60 h. p. of boiler capacity will amply take care of the maximum as well as the average rate of consumption due to the variations of load.

The same misconception of the "state of the art" leads the *Review* to suggest that some mechanical device may be developed which would enable the speed of the engine to be augmented as the power increased without augmenting the speed of the dynamo. It think it beats even our boasted Yankee ingenuity to see a decent way to accomplish this. We submit that it is much more sensible to attack the problem from the other end and work out an engine which shall be insensible in its economy to variations of load, and thereby go direct to the point desired. The *Review* may at once dismiss from its mind any modification or mechanical devices to meet excessive fluctuations of steam consumption, and may deal with the problem as one of practical uniformity.

With reference to the question of condensing, I have only to say, that for years I have steadfastly refused to consider the condenser as a part of the power. In other words, I would proportion the engine so as to be adequate to the maximum load without the help of the condenser, and treat the condenser only as a device to secure additional economy. This is at least on the safe side, and brings with it no drawback.

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[1] See page 175 of this issue.

In view of the foregoing paragraph, the question of how close a margin we should work to in the capacity of the engine itself, would depend of course upon the nature of the service to be performed, whether continuous, or subject to extreme fluctuations. I am quite inclined to coincide with the *Review* that in railway work, "the engine capacity should be such as to just overcome the maximum load with steam carried full stroke (?) in the cylinders." The only trouble is, that in said railway work, I have never yet been able to find out what the maximum load is, but I am always willing to work my engine up to the utmost extension of its valve motion, whether condensing or otherwise, to meet the extreme of load, whatever it may be.

It is true that the greatest extremes are to be found in the smaller stations, of which my articles are now treating, but engineers must not for a moment be deceived into thinking that a large station implies anything like a uniform load, as understood in mill work. Beautiful evidence of this fact is to be found in a recent issue of THE ELECTRICAL ENGINEER, in the report of Messrs. Shepardson and Burch on sundry tests in the Minneapolis Street Railway power station. In this station the load was seen to almost constantly fluctuate between 1,000 and 1,400 h. p., with occasionally spurts to nearly 1,800 h. p., a degree of fluctuation fatal to the economy of any type of engine as ordinarily designed.

POINTS IN POWER STATIONS.[1]

IN THE ELECTRICAL ENGINEER of July 6, Mr. Lee Church has some correspondence on the above subject, and with much of what he has to say it is not difficult to agree. On one point, especially, he is very much in the right, and that is the proportion of boiler power necessary. When Mr. Church confesses that he is a steam engineer, and yet boldly confesses also that he did not foresee any better arrangement than to put four boilers each of 60 h. p. capacity to drive two engines of 100 h. p. each maximum capacity, in an electric railroad power station, we admire his pluck and despise his judgment, for he did not see the folly of it until he found that two boilers would do all the work easily. If some electrical engineers had their own way, they would use boilers holding about a tenth the proper quantity of water, in utter disregard of the fact which Mr. Church sees now so plainly, that the steam boilers of a station merely require to be large enough to turn out steam at the *average* rate of daily consumption, but that the engines must be big enough to give the maximum power requred, even if they carry steam full stroke to do it. Of course, the average rate of steam consumption per horsepower is necessarily high, and the boilers must be proportioned to give steam for this same high rate, but not for more than this; for with a proper water capacity, the inertia of a steam boiler is large, and will enable it to yield steam to carry on over high points in the energy diagram, and absorb heat from the furnace at periods of comparative idleness.

These points have been drawn attention to in the columns of the *Electrical Review*, specially with reference to the advisability of carrying large amounts of water. The advocates of boilers with small water capacity are very apt to conclude that rapidity of steam generation implies economical performance, and go so far even as to state that when a station ceases work for the day, the stored heat in a large bulk of water is lost, quite forgetful that during the last few minutes of working, the fires will have been let down and steam dropped to its minimum, and the water level also allowed to run to a minimum, and they further overlook the fact that the smaller the water capacity in a boiler, the more nearly must the heating surface and furnace capacity approach to that corresponding with the engine power necessary to pull over the high points. Where the water capacity is zero, as it may be considered in that proposed boiler wherein water is injected upon heated surfaces and the whole is flashed into steam instantly, then it would clearly be necessary to maintain a maximum fire and maintain it, too, right up to the last instant of work. In what he has to say of boilers, Mr. Church now appears to have a clear insight into the matter and to have profited by the error for which he states he was a bit ashamed. He was in good company, however, in his error, for if the evidence against the proposed Central Subway Railway in 1889 be referred to, it will be seen that a noted "Sir" scientific witness, whose absolute veracity it would be flat blasphemy to doubt in the least, did not appear in his evidence to be at all clear in respect to proper allowances for varying loads.

We cannot, however, agree with Mr. Church that engine capacity must be determined without reference to condensation, when present; to neglect the power given by condensation is practically to allow of a more serious underloading than already compulsory, and where there is a sufficiency of condensing water there need be no occasion for the condenser to become choked, disabled or leaky, or to lose its vacuum under a sudden fluctuation. Any detail may become disabled, but there is no reason more for fearing this of a condenser than for any other part, and as to losing its vacuum, through overheating (which we assume is what Mr. Church means,) the same arrangement which gives a sudden accession of steam to be condensed can at least be made to give a sudden accession of water wherewithal to condense that steam, and, too, at least one stroke ahead of the advent of that steam to the condenser. To neglect the condenser is by no means a corollary of the action of the steam engine; for the injection valve is as easily regulated automatically as are the steam admission valves, only it is not so often done, because, ordinarily, steam engines work at fairly regular speeds and powers, and the injection valve is opened by hand by the engineer, who keeps his eye on the vacuum gauge as he does so, and usually gives a little more admission of water than he finds is sufficient to maintain a full attainable vacuum. Mr. Church's remarks here savor just a trifle of that rule of thumb, which he condemns when properly denouncing the errors in choice of boiler capacity.

Mr. Church makes the reservation that his remarks anent relative capacities of engine, boiler, and dynamo at what we may term a proper standard rating of each, are to be more especially understood as applying to small stations, rightly concluding that over a large system actuated from one station the chances are in favor of a far more close approximation of maximum and minimum load to the dead level of the daily average than can be the case on a small road of a few cars only. With numerous cars, the expenditure of energy will be in all likelihood extremely regular, and within the economical limits of variation of the engines, whilst, of course, the boiler capacity will be simply that of the engines. For small stations he inclines, however, to the proportion:

Dynamo	100
Engine	100
Boiler	60

For he considers the dynamo, like the engine, may for any short periods be run above its proper rating, as it will not become dangerously overheated in the short period of maximum effort.

It may not be an easy problem in mechanics to solve, or even within the range of practical possibilities, but one of the best methods of getting an engine to do more work with economical rates of expansion would be to so arrange the driving connection between the engine and dynamo that the speed of the engine could be augmented for the higher powers whilst keeping that of the dynamo constant. The change would require to be so quickly effected that it is not clear how it could be carried out.

Mr. Church considers 20 to 25 per cent. the outside excess above its rated capacity to which an engine should be made to work. Even with this the engine must be enormously too large for its minimum duty, which may be nil on the ampere diagram, and he gave illustrations in the original article to which he now refers, of some indicator diagrams showing 33 per cent. overload above normal; but as no scale or other figures are given, we cannot compare any of the diagrams fairly, or know if the standard diagram was such as to commend itself to our judgment; but our impression from this appearance is, that the normal load is a heavy one, and the true rated capacity less than that allowed, so that the maximum load is really more than 33 per cent. above a proper normal.

Considering how short is the actual period of maximum load, it almost seems that the engine capacity should be such as to just overcome the maximum load with steam carried full stroke in the cylinder. This may not be economical, but the loss due to a few cylinderfuls of steam thus expended will often be less than the long-continued loss consequent on so much running at almost a friction-diagram rate of work.

CAPTAIN WILLIAM BROPHY, well known to all electricians throughout the country as inspector of electric light stations for insurance purposes, has become connected with the Manufacturers' Mutual Insurance Company (commonly known as the Factory Mutuals), who have now decided to take up the risks of insuring electric light and power stations. Captain Brophy will himself inspect all the stations, wherever situated, insured by this company, and will at present make his headquarters at No. 31 Milk street, Boston.

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[1] The *Electrical Review*, London, Vol. XXXI, No. 765, July 2, 1892, page 96.

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VOL. XIV. NEW YORK, AUGUST 24, 1892. No. 225.

The discovery of magneto-electricity is the greatest experimental result ever attained by an investigator.—Tyndall.

ELECTRIC RAILROADS IN THE CITIES.

FOR some weeks past several of the New York daily papers, among which may be named the *World*, *Times* and *Post*, have been displaying an unusual amount of misinformation and prejudice on the subject of the trolley system. It would be difficult to give a synopsis or summary of their variously vituperative articles, for the reason that there are practically no facts and no figures, but simply a wearying reiteration of the statement that the trolley is a bold, bad, deadly thing, and therefore New York will have none of it. It is true that the *World* has presented a list or two of alleged trolley accidents in other cities, but when one comes to examine them the absence of *trolley accidents* is truly remarkable. Some people are unfortunately run over, and others again get hurt by putting their heads out of car windows or by jumping off on the wrong side of cars in motion, or by losing control of teams; but as for accidents in which the wires or the trolleys or the motors play any part, they are well nigh undiscoverable. That is just what might be expected. It is possible that some day one of these papers will invent a method of traction in which no accidents will happen; but in view of the fact that our steam roads, with all their magnificent advances and improvements are still killing and injuring about 30,000 persons a year, it does seem rather unreasonable that these critics should ask a new system, carrying annually in America the equivalent of the population of the globe, to be absolutely and entirely free of casualty.

A somewhat surprising aspect of the losing agitation against the victorious trolley is that one or two technical journals have joined in the chorus of dispraise. For instance, the *Engineering Record* says: "The problem of passenger transportation through the streets of New York is largely one of rapid transit. There is no good evidence to show that it would, or could, be solved by any of the trolley systems which have been held in view. The whole merit of the systems would be found simply in the low operating expenses, and in these, manifestly, the public could have little interest, deriving, as it would, no measureable benefit from them. Why, therefore, any sacrifices, important as they would be, should be made to the trolley systems, remains to be shown." We would like to know whether our contemporary is seriously and fully of the opinion that the public has but little interest in economy of operation, and whether it believes that an electric railway is any different in such a respect from any other work of public utility that adds to the public wealth by its greater product of some needed commodity at a lower cost of supply. If the *Engineering Record* is right, all inventors and engineers may as well stop right off.

But perhaps there are other advantages to the public from the trolley system than the mere reduction of operating expenses. As an alternative to horse cars it seems to have some merit. It is certainly far less unsightly and cumbersome than an elevated road. Beyond question it is far more cleanly and healthy in its operation and surroundings than either a horse railroad or an elevated steam road. We should suppose it had some superiority over a cable road as being less costly to build and operate, with greater control of the cars, and at least an ability to back a car instantly when necessary. We have understood that a great many electric roads have re-endowed many American citizens with their birthright—a free home—enlarging the area of prosperous municipalities and building up beautiful suburbs where the humblest may sit under his own verandah and apple tree.

It is a strange sensation for a New Yorker, like ourselves, to come back to the city after visiting other places blessed with electric roads, and to settle down to the old humdrum horse cars. A trip two weeks ago to Scranton showed us a city with not a single horse car in it, but with electric cars in every direction used as freely and gladly by the people as though they had been there since the year in which the city was founded. Or if one has been in the Northwest he will have visited Minneapolis, where the electric cars last year carried 26,500,000 passengers, and where this year the travel on the electric lines is many per cent. heavier than in 1891. Or perhaps we may take the report of Boston, where on the Fourth of July over 600 electric cars carried hundreds of thousands of people in comfort and safety. The annual report of the West End Company of Boston, just published, shows that electricity is there doing a work that no other motive power could have done, and that the trolley has been patronized by the public to such an extent as to make the stock of the company one of the best investments to be found in that staid and shrewd city, an investment, morever, that is pretty well distributed among the proletariat of capitalists constituting the conservative element of the community. If the trolley is a failure in Boston, as some of our New York newspapers contend, the price of the stock, the rapid extension of the electric system, and the demand for trolley roads where none have yet been put in, are good evidence to the contrary.

By all means, let us have every storage battery car we can; and conduit roads, too, when we may; and underground roads as soon as possible ; but their development and the general cause of rapid transit are not going to be benefited one bit by dispraise of one of the simplest and greatest inventions of the age—the humble, useful trolley. The trolley is here to stay.

A PROTEST AGAINST "TEMPORARY" WORK.

Cheapness, carelessness and ignorance have been chief banes of electrical progress, and the wonder in many cases is that the combination of these three detrimental elements has not resulted in greater disaster and loss. As Mr. C. O. Harris points out in this issue, in a characteristic and suggestive article, many electricians have been slaves of the word "temporary," and have allowed themselves to be ensnared by the idea that the best work is not required at all times. Even where a willingness is shown to spend large sums of money, temporary methods are adopted, as for example in Boston and Brooklyn, where the electric railway feeders may be seen over the tracks, when everybody knows that they would be much better underground and would cost less in the long run, to say nothing of the good effect on public opinion, secured by their removal from the poles.

As to installation work, there is still much room for improvement. The report of a well-known insurance inspector which is now before us, says of a leading town in New Jersey: "The wiring in this town is exceedingly poor. I inspected 25 buildings and found them with few exceptions in the same condition. I explained to owner of electric plant that it was useless to supply him with our certificates until improvements were made in the different buildings." Of another Jersey city, he writes: "The wiring in this town is exceedingly bad in many places; very little attention appears to be given it, the work being done in a very careless and incompetent manner."

If all contractors and central station managers were really earnest, conscientious and intelligent in their work, there would be little opportunity for such reports as these. In fact, we think that local companies should not wait for the coming of the insurance inspector, but should try to live up to a high standard and should reinforce their own efforts by calling in once or twice a year some outside engineer or firm to make an inspection of plant, circuits and wiring, and tell them of any defects. It would be a saving in the end.

IMPORTING SUBMARINE CABLE.

Under the new McKinley tariff law, importations by the U. S. Government are no longer free of duty. As the result of these changed conditions, Prof. Harrington, Chief of the Weather Bureau, informs the Secretary of the Interior that the cost of the cable for two proposed weather signal stations on islands in Lake Huron is doubled. His original estimate of the cost of seven miles of cable was $10,500 or $1,500 per mile, but he now wants $21,000 or $3,000, to meet the additional cost on account of the duty.

Aside from the point that this would seem to indicate that the consumer pays the tax, and not the foreign manufacturer, we would respectfully inquire what is the use of the duty, if the Government is still to go abroad for its submarine cable? Either the manufacturers here can make this cable, or they cannot. If they are able to make it, we object most decidedly to any purchase of foreign cable. If they cannot make it, or do not care to make it, the duty should come off, as it is certainly then a useless and senseless tax, like many others that the tariff imposes.

We believe that this country is able to make its own submarine cable if it chooses. What do the manufacturers say?

ZINCS FOR GRAVITY BATTERIES.

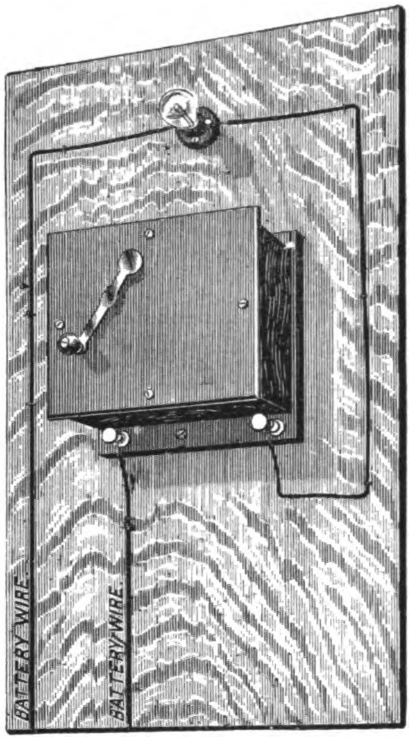
One of the most valuable improvements made of late years in gravity batteries is that to which Mr. Georges d'Infreville, formerly electrician to the Western Union Telegraph Company, calls attention in this issue. He has taken the old crowfoot zinc and so transformed it by his inventive genius that he may be said to have given a new and long lease of life to that familiar servitor of the telegraph. The economy that he proposes to effect is by no means insignificant. It is understood that the Western Union uses about 750,000 zincs every year, and if we allow but as many more for all the other telegraph systems and appliances of the country, including the Postal, the railway companies, the district messenger and other users, we find a consumption of about 1,500,000 zincs per annum. With Mr. d'Infreville's simple, beautiful and highly ingenious improvements, the consumption can be greatly reduced, the waste abolished, and the service materially bettered. We must confess our admiration of the inventive faculty that can thus see in the most familiar and commonplace objects a large opportunity for its employment, and we trust that Mr. d'Infreville will enjoy some return for the work and study by which through several years of steady experiment he has brought his devices to perfection. It will be noticed that his initial modification of the zinc has brought with it a number of corresponding changes throughout the gravity cell, each requiring careful adjustment and each yielding its better result in a wider application of this type of battery.

THE MODERN SEARCH LIGHT.

This week Mr. E. R. Knowles completes his very interesting and instructive series of articles on search lights by describing and illustrating one in which he has embodied the latest ideas in this field and has produced an apparatus of great value. The papers have lately been full of accounts of the wonderful search light installed on top of Mt. Washington, in the White Mountains, and sending its beam of pure white light over half a dozen States. It is worth remarking that the light in question is the same as that described by Mr. Knowles. The effects obtained with it are very beautiful, and there is no reason why every ambitious and self-respecting mountain hotel should not get a similar equipment, with which to fill in the pauses of the moon.

THE EDISON TIME SWITCH.

THE accompanying illustration shows the new time switch of the Edison Manufacturing Company, which is operated by a clock movement. It is designed for use in connection with miniature incandescent lamps for cellar or basement lighting; the current being supplied by six Edison-Lalande cells type, K. The battery and lamp can be placed in the cellar, and the switch at the entrance, so that the lamp can be switched on before entering. It is impossible for the lamp to be left burning, through negligence, as the switch opens the circuit automatically, at the end of either 2½, 5, 7½ or 10 minutes' run, the time depending upon the number of turns given the switch handle, each turn adding 2½ minutes to the length of contact.



EDISON TIME SWITCH.

The mechanism has a Geneva stop movement, one of the cogs being attached to a brass contact wheel having an insulated section with a V-shaped notch cut in it. When the switch handle is turned and the clock wound up, a contact spring is brought to bear against the metal part of the contact wheel, and the circuit is established. As the contact wheel slowly revolves, the insulated section on it finally reaches the contact spring which locks into the V-shaped groove breaking the circuit and stopping the clock. The switch is placed in series with the lamp as shown in the cut, and it is possible to operate three or four switches and lamps in different parts of the house from one battery of six cells, as only one lamp would be in use at a time.

The battery will maintain a four c. p. lamp for 100 hours without needing any attention, and, estimating that the lamp is used on an average 20 minutes daily, the battery would last about a year.

One great advantage offered by this system of lighting cellars, etc., is the absolute safety from fire; coupled with the great convenience of the light being always ready for use. The entire outfit which consists of a time switch, one four c. p. lamp and socket with the necessary wiring and six Edison Lalande cells, type K porcelain jars, can be seen at the offices of the Edison Manufacturing Company, 110 East Twenty-third street, New York, in actual operation.

THE STROM AUTOMATIC ELECTRIC SAFETY BLOCK SYSTEM.

A VERY interesting test took place recently on the Brooklyn and Brighton Beach Railroad of a new block system, differing from others in that it gives no visible signal, but instead automatically shuts off the steam, puts on the air brake and blows the whistle whenever there is danger of any kind, or any part of the apparatus is out of order.

In each locomotive cab, Fig. 1, an eighth h. p. dynamo, fastened to the ceiling, is kept constantly running by a direct-coupled rotary-engine, taking steam from the locomotive boiler. This supplies all the current, there being no batteries used. In front of the throttle a small cylinder, A, is so placed that when steam is admitted, its piston forces the throttle piston in, shutting off the steam; the piston of another very small cylinder, B, fastened to the ceiling, pushes the whistle handle down and blows the whistle, while a third cylinder, D, having a piston with a radial motion, puts on the air brake. These cylinders are connected to the boiler through a valve, which is normally kept closed by an electromagnet.

Underneath the locomotive are two parallel brushes (one to be used going forward, the other backwards) and on the track, at the end of every block are four steel contact plates connected to inter-locking boxes along the line, as shown in Fig. 2. The electromagnet and valve on the locomotive is a very compact and practical piece of mechanism. It is seen at E, Fig. 1, and again enlarged in Fig. 3. The valve has its parts so arranged that when open the steam goes from the boiler to the cylinders, but when closed the steam escapes from the cylinders to the outer air.

The magnet, Fig. 3, is iron clad with grooves on two sides, and slides up and down on a track on the frame. A coiled spring and pin are placed in the centre, which forces it from its armature as soon as released. Another coiled spring gives the armature a radial motion. A post in the armature forks down over the handle of the valve. When the magnet is up, away from its armature the current is short-circuited across it. In use the handle of the valve is turned to the right and the magnet is pushed down. This breaks the short-circuit, and it clicks down upon the armature A short rounded pin in the latter enters a hole in the magnet and prevents the armature from being twisted round. Friction will hold it, but the pin is considered safer. The magnet is about 3½ inches long by 3 inches outside diameter and will sustain over

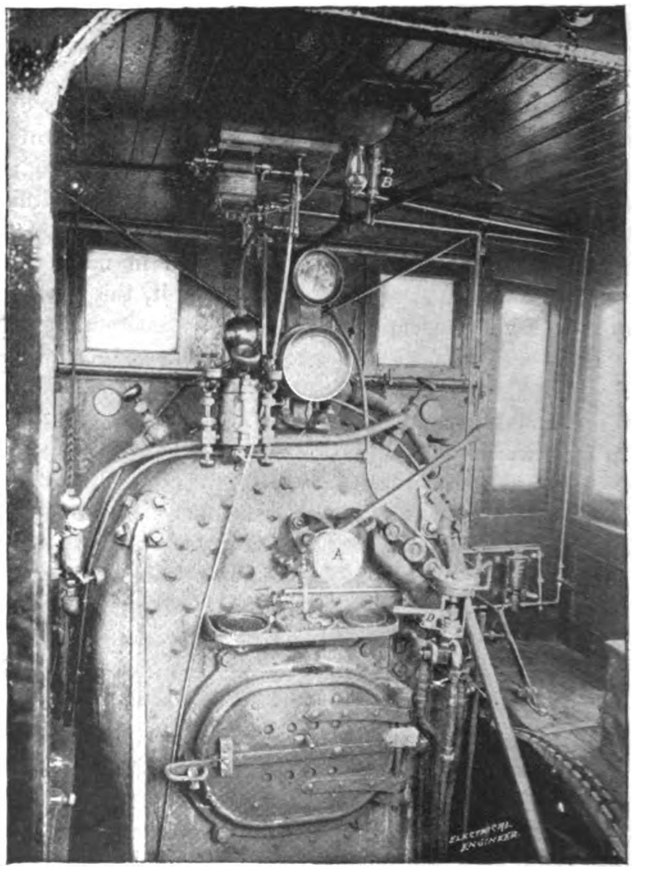


FIG. 1.—STROM BLOCK SYSTEM.

800 pounds, so there is no danger of its being shaken loose from the armature. When the current is broken the magnet springs up, the armature turns round, carrying the valve handle with it,

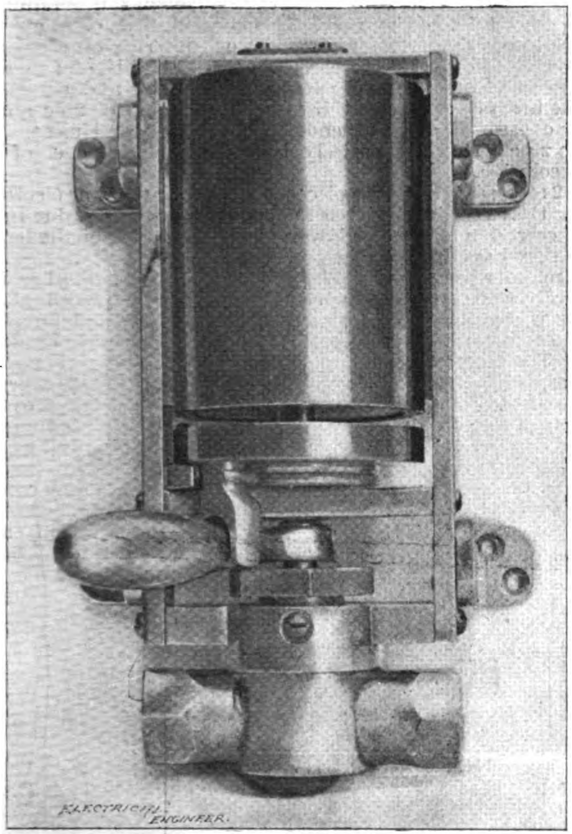


FIG. 3.—ELECTROMAGNET AND LEVER.

and allowing the steam to go to the three cylinders for stopping the train.

Except when going over contact plates the circuit is closed on itself on the locomotive, as shown in Fig. 4. From the dynamo it goes to an automatic switch that connects to either brush, thence through a contact to a resistance coil, equal to sum of line and inter-locking box magnet, thence to the engine frame and ground. In case of protecting against broken trains, a wire would be carried through the train and grounded on the last car. The other terminal of the dynamo is connected to the magnet, the other end of the magnet wire being grounded through its core.

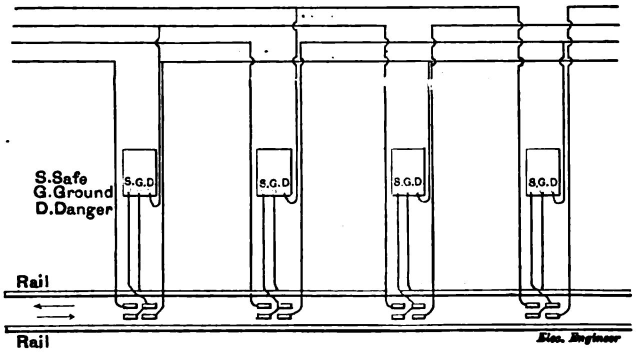


FIG. 2.

The line boxes, Fig. 5, also deserve special mention, being very simple, compact and substantial. There are no adjusting screws, pivots or hinges to get out of order. Once in order, always in order, is what is claimed for them. There is only one point of make and break and that has a quadruple platinum contact. The operation is as follows:

When the brush of a locomotive comes in contact with a plate the brush is lifted, breaking its regular circuit, but making it through the contact plate to the line through the quadruple contact in the box two blocks ahead, through the lower magnet in the line box, to the rail and engine. The lower magnet lifts its armature, which releases the vertical arm, and this in turn allows the other, as soon as the current is broken, to drop below its former point, and thus break contact at the platinum points. Another train coming over the same contact plate would meet this broken circuit and be stopped, as would also a train coming from the opposite direction two blocks the other side of the box, as a contact plate there is also connected to the same binding post. The brush immediately goes over another plate (the two are combined in one with insulation between forming a double plate, as shown in Fig. 6), which is connected to the upper magnet of the box nearest to it. The vertical arm is attracted, and this lifts the horizontal arm against the contact points and locks itself. This allows a train to pass over the contact plate two blocks in the rear, one block in the rear being still protected by the box one block ahead. Switches, drawbridges, etc., are protected by placing a contact plate at a safe distance for stopping, and connecting them to contacts that are made or broken by the closing or opening of the switch or bridge.

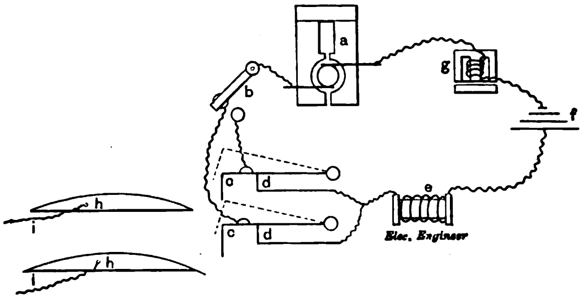


FIG. 4.

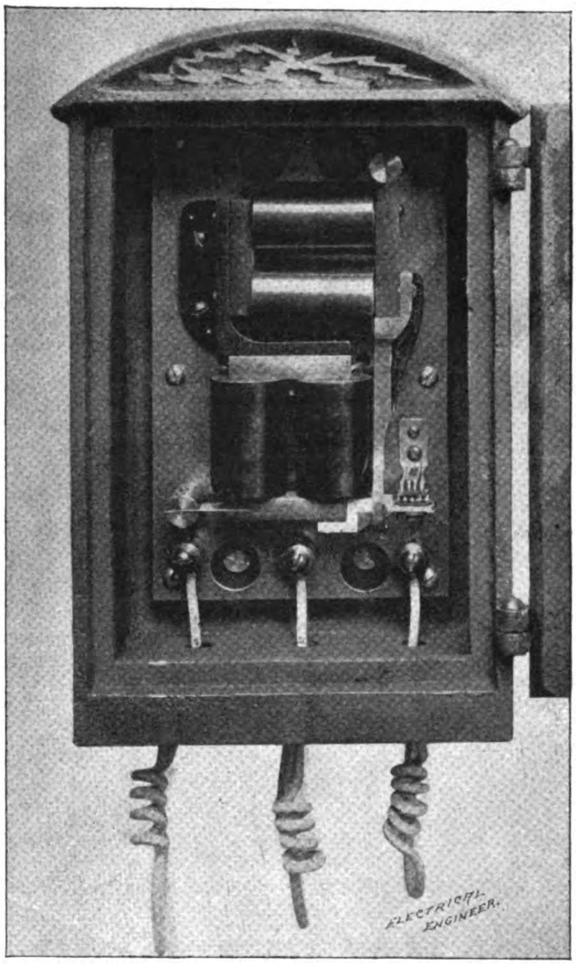


FIG. 5.—LINE BOX.

The dynamo used for the experiment was an eighth h. p. 50-volt shunt-wound Perret machine, running at 2,200 revolutions directly connected to a one-third h. p. Turner rotary engine. The same dynamo may be utilized for operating a head light and gauge light. The company are at present constructing a special dynamo and engine that will contain many novel features, and which will be described in a later issue.

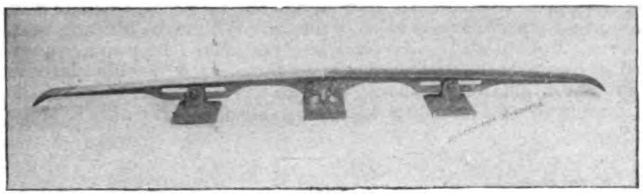


FIG. 6.—CONTACT PLATES.

This system is said to be less expensive than others to install, and the cost of operating is almost nothing in comparison. It is also said to take a great mental strain from the engineer. But the most important claim is that, in order or out of order, with the engineer asleep, dead or off his engine; in fog or darkness, it can never fail.

Great credit is due Mr. Harry E. Dey, the electrician of the company, for the energy and ability displayed in putting the system into successful operation. In two months he designed every part, and had two miles of track and two locomotives fully equipped, meeting with the most gratifying success at the first trial. Mr. Dey has an able co-worker in Mr. F. J. Clark, of Harrison, N. J.

THE D'INFREVILLE WASTELESS GRAVITY ZINC.

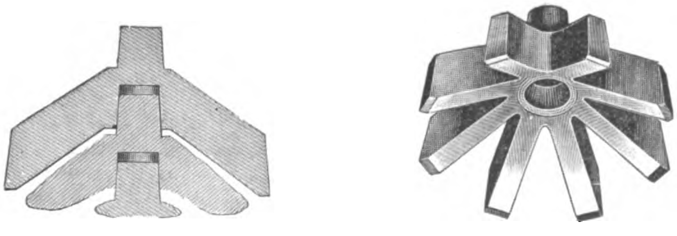
BY

G. d'Infreville

HERETOFORE there has been a great waste of zinc in batteries, owing to the fact that the zinc electrode must be removed before it is entirely consumed, the current having become too weak on account of the increased internal resistance due to the diminished size of the zinc electrode. This waste in the case of the best patterns of zinc for gravity battery, often reaches forty-five per cent. of the total weight of zinc purchased, 1½ pound being wasted out of 3¼ pounds of zinc.

In many places the stumps cannot be used to any advantage, nor sold, and it will not pay to gather and ship them to a place where they can be disposed of. Even when collected, they can at best be sold only as impure metal at but about half the price of spelter, so that in the most favorable case, where one-half of the value of the stumps is recovered, the loss will still amount to about twenty-two per cent.

The invention here illustrated was devised by Mr. Georges d'Infreville of this city, and consists in using for the zinc electrode a number of pieces adapted to be connected to one another in column by joints or connections which are liquid-tight or adapted to preserve the connecting parts from the action of the battery liquid, so that a partially consumed piece may be connected or attached to the bottom of a fresh or new piece, which latter, after being partially consumed, and after the still greater state of consumption of the first one, may in its turn be connected underneath a new piece, and so on.



FIGS. 2 AND 3.

In time the lower piece of zinc will have been *entirely consumed;* then the one directly above it and to which it was attached, and so on, so that practically every piece of zinc introduced into the battery will in its turn be entirely consumed. This fact has been repeatedly confirmed by experience, and the electrode is therefore called the "Wasteless" zinc.

This arrangement and process are shown in perspective in Fig. 1, which represents one complete gravity element fitted up with the "Wasteless" zinc electrode. This consists, first, of a new zinc piece suspended from a hanger resting on the rim of the jar so that the zinc dips about half way into the sulphate of zinc solution; a second piece of zinc partially consumed and suspended from the first one; and of a third piece or stump of zinc almost entirely consumed, and suspended from the second piece. The last two zinc pieces are entirely below the upper level of the battery solution.

Fig. 2 represents the three pieces constituting the zinc electrode, showing their relative positions and comparative sizes, due to the state of corrosion of the two lower pieces depending on the length of time they have been in use.

The manner in which a "Wasteless" zinc piece, whether new or partially worn out, is fastened to another one placed above, makes it perfectly secure, both as regards contact and guarding against any possibility of dropping down on the copper electrode below. The fastening is obtained by means of the slightly conical socket provided at the bottom of the upper zinc, Fig. 3, over the correspondingly tapered complementary stud or shank provided at the top of the zinc, Fig. 4. The socket below each zinc is an inverted cup and cannot allow, any more than a diving bell would, the access of liquid to its inside walls.

The two zinc pieces are so strongly connected that they cannot be torn asunder when pulled straight apart; but a twist, combined with light tapping sideways on the radial branches will easily loosen them when desired.

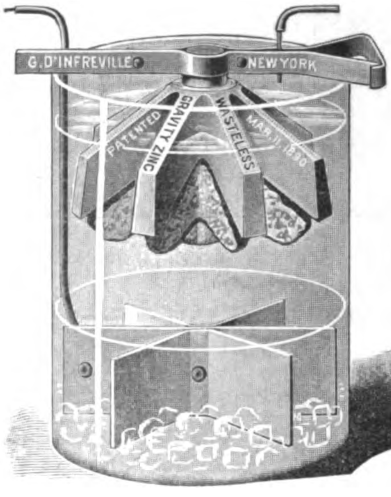


FIG. 1.

The conical stud or shank above and the conical socket below each are made to a uniform gauge, so as to leave about ¼ inch between two zincs when the branches of the upper one are exactly over the branches of the one below, which position permits the introducing of the blue vitriol, and the use of the hydrometer. The gauge will be preserved in the future for this size of zinc, so that the stud or shank of a zinc previously bought will always fit into the conical socket of a newly purchased one.

This is a simpler and cheaper method than connecting them by a screw thread and has proved to be quite effective and reliable in practice.

A new feature with this is that the radial branches are slanting downwardly from their supporting trunk so that they will wear out gradually from their extremities as shown in Figs. 1 and 2, which are lower in the solution or nearer to the copper electrode, towards their point of support which is higher in the solution or farther from the copper, and hence less acted upon chemically; the branches will thus become entirely consumed before their support is itself too much corroded.

Another advantage secured by the downward slant of the branches of the zinc, is, that some of the hydrogen gas runs up from under the branches towards the socket under the trunk of the zinc where it helps to preserve it from corrosion and whence it bubbles out from time to time when in excess, while it leaves the branches free to be acted upon by the solution. The slanting direction of the branches also furnishes at the lower part of the zinc a space which a partly worn-out piece or stump will fill advantageously, so that the zinc electrode will be more even at its lower part.

When a battery is started a single "Wasteless" zinc, or, if a greater ampereage is needed, two, one on top of the other, can be suspended in the same jar, the upper zinc from a hanger connector, Fig. 5, which rests on the rim of the jar, and the lower zinc under the upper one as explained before.

The "Wasteless" zinc furnishes in itself means for connecting firmly together two or more new or partially worn-out pieces of zinc, without the help of mercury or anything else below the outside level of the battery solution, and beyond the possibility of being corroded by it.

This radical departure brings with it, besides the possibility of totally consuming the zinc, several other advantages, some of which are of great importance.

As a new "Wasteless" gravity zinc can at any time be put over another partially consumed one, there is no occasion for hesitating about the proper time to replace a partially worn-out zinc, for fear that doing it too soon would entail too great a waste of metal, or that doing it too late would allow the internal resistance of the battery to so increase as to fail to produce the necessary amount of current.

This special property is of the utmost value in many cases, as for fire-alarm telegraphs, railroad telegraphs and signals, police telegraphs and alarms, and whenever the utmost reliability outweighs any other consideration. Among the immediate beneficial results derived from the lower internal resistance due to the simultaneous use of two zincs, one under the other, and one stump under the lower zinc in the same jar, is the saving of 50 per cent., it is claimed, in the expense of now superfluous jars and coppers, of 50 per cent. in amount of room required, and of 40 per cent. in total battery weight, and also the resulting saving of money and time in packing, handling, shipping, storing and attendance, with the reduction of risks, delays, etc.

In addition to this, the internal resistance falls to 0.7 ohm per cell, the E. M. F. being 1.07 volt as usual, giving a current of about 1¼ ampere; they are, therefore, well suited for operating circuits of moderately low resistance, such as local telegraph circuits, electro-plating and the working of small motors, in which case one single cell equipped with two zincs will do about as much work as three ordinary cells alike in every respect except as regards their zinc electrodes, which necessarily are single and generally placed further away from the copper.

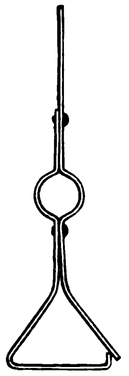


FIG. 5.

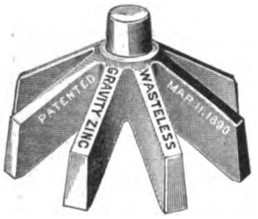


FIG. 4.

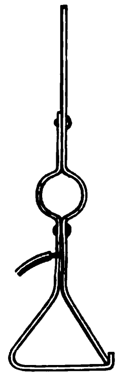


FIG. 6.

The projecting stud or shank of the "Wasteless" zinc, being less than one inch in length and in diameter, and free from holes, is strong and less liable than any other of its parts to get broken in handling or transportation. The radial branches are eight in number, all alike, and separated one from another by an angle of 45°. They are also sufficiently short (2¼ inches) and thick (from ⅜ inch at the top to ¼ inch at the bottom) to not be easily broken.

These zincs when packed are placed on top of one another in piles of ten, and a small metal ring of proper dimensions is placed around the stud of each zinc to prevent its being wedged into the socket of the zinc placed directly above; they thus occupy much less room than other patterns and are easily packed in a wooden crate.

Five or ten, as desired, of the hanger connectors can be easily and safely packed with ten zincs, at the upper part of the crate. Five or ten coppers, if needed, can also be packed at the lower part of the crate and are there maintained by an extra strip of wood. No other pattern of gravity zinc takes less room and material for packing and storing.

The "Wasteless" zinc is made only at present for the standard and most generally used glass jar which measures six inches in diameter and eight inches in height. The zinc weighs nearly three pounds, as this weight for several reasons has been deemed most advantageous for this size of jar, while, should it be desired to have a much larger or heavier zinc electrode in the jar, it could be readily obtained with the "Wasteless" zinc, for when two pieces and a stump are assembled in the same jar, the total weight of the zinc reaches about seven pounds.

This zinc has been in actual continued use for the last year in many places. It is finding a steadily increasing demand and general favor as it becomes known and understood, and has as yet given no cause for complaint. It has also, it is claimed, opened new fields of application for the gravity battery. It has enabled the sulphate of copper gravity battery to be now economically applied to the operating of printing telegraphs, the running of small electric motors, electroplating, medical apparatus, the charging of small accumulators, etc.

The hanger connector, Figs. 5 and 6, is made simply of two pieces of brass fastened together, has no screw whatever, weighs but about two ounces and takes little room. It provides a broad, elastic and tight connection all around the stud of the zinc which it supports. On one side it is triangular, so that the whole rests by three points on the rim of the jar, giving sufficient steadiness to the zinc, while its edgewise position gives it all the rigidity necessary to safely support at the same time two or more zincs connected in a column.

Its triangular end serves also to fasten and securely lock either a wire or a metal strip, not necessarily by the end, as when a screw with a hole is used, but at any place, from the smallest magnet wire to the largest telegraph office wire, always with a nearly uniform pressure, ample contact and an elastic grip not liable to get loose. It does not strain nor tend to break the edge of the glass jar, and renders the connecting and disconnecting easier and quicker than with a screw, an advantage often very important in large battery-rooms or in unforeseen emergencies.

THE BALTIMORE AND PIKEVILLE ELECTRIC RAILWAY CO.

THE first regular car of the Baltimore and Pikeville Railway Co. was recently run over the newly constructed line. This is the first line to be equipped by the Baltimore Traction Co., and marks an era in rapid transit in Baltimore. This line runs from the northern boundary of the city to Pikeville, through a thickly populated region, which is being rapidly built up. It replaces an old horse car line, which made the trip in about 1¼ hours, the new schedule on the electric line being 25 minutes.

The equipment consists at present of two Short, and two Westinghouse motor equipments. The station equipment consists of two 100 K. W. Edison generators, which are driven by two engines of the Ball Engine Co., of Erie, Pa. The switchboard is of marble and is tastefully arranged, the entire station work having been put in by the General Electric Co., of New York.

The track work was put in by Messrs. E. D. Smith & Co., of Baltimore, and consists of girder rail on chairs in the city, while beyond the city limits the 56 lb. T rails, made by the Maryland Steel Company, of Baltimore, are used. The track is well laid and ballasted, and the cars run extremely well on it. There are several grades on the road, one being of 8 per cent., but the cars move easily and smoothly.

The line work was done by J. G. White & Co., of New York. It is an excellent piece of line work, consisting of iron poles, side construction in the city, and outside the octagonal Norway pine pole is used with bracket construction.

The manner in which the engine foundations are built deserves attention. They are placed on the main floor of the Traction Co's Retreat street power house. As the cellar is used for splicing and repairing cables, the space was too valuable to occupy with foundations, so it was determined to use four steel girder I beams, resting in the wall of the building and the cable engine foundations, to support the engine foundation. Between each of these beams was thrown a brick arch on top of which was built the foundation. This answers admirably, and the engine runs without a jar of any kind. In fact, the whole line runs extremely well and promises to be a splendid feeder for the cable line as well as carrying large numbers of people to Pikeville and other suburban towns along the route.

THE NEW ORDER OF THINGS AT CAMDEN, N. J.

ONE by one the earlier electric roads started at low voltage, etc., are coming over to the new order of things, and Camden, N. J., is the scene of the latest of these changes. Mr. J. Stanford Brown, the electrical engineer of New York City, has been busy lately making the necessary alterations in the old Daft system there, running at 220 volts and with double overhead wires, and has now started up the first car on the Westinghouse system at 500 volts, single-trolley circuit. The change over was made without a hitch on August 9, and if nothing interferes, the Merchantville extension will be ready to operate this week, the track being already completed. It is noteworthy, and creditable to Mr. Brown, that the change on the old line has been accomplished without any stoppage of the cars. Mr. Brown is in full electrical charge of the work for the Camden Horse Railroad Co., owners of the entire system of lines.

"AT ANY PRICE."

THE electrician of an electric light company in the South writes us: "I am a subscriber to your paper and would not be without it at any price."

Letters to the Editor.

THE TYPE TELEGRAPH OF THE EXCHANGE TELEGRAPH CO., LONDON.

As an old subscriber to your weekly journal of electrical engineering, I was rather surprised to find in the number just to hand, dated 27th July, an account of an "American Type Telegraph," in which the employment of my apparatus, which is of a similar character, by the Exchange Telegraph Co. in London for many years past is completely ignored, while at the same time a statement is made that a page printing machine by Mr. J. E. Wright, of New York, has been working successfully for the past three years *in all* the leading newspapers and clubs in London, while the fact is that the bulk of the business is and has been done by the Exchange Telegraph Co., and the apparatus of later production of Wright & Moore is at work in a small proportion only of the London clubs, about a dozen at the outside—most of which would be rather surprised at being distinguished as leading clubs.

I enclose a specimen of the performance of our "Column Printer," which last month delivered a total of 5,465,740 words.

The high speed of 400 revolutions per minute said to be obtained by the Wright apparatus must be unnecessary for turning out only 40 words a minute.

We can manage that number of words at 140 revolutions per minute or 80 words at our normal working speed of 100 revolutions.

J. HIGGINS,
Engineer, the Exchange Telegraph Co., Ltd.

LONDON, ENGLAND, August 4, 1892.

LAMP AND WIRE CALCULATIONS WITHOUT TABLES OR CURVES.

IN the article on "Lamp and Wire Calculations Without Tables or Curves," by Mr. E. P. Roberts, in your issue of Aug. 3, 1892, which I have read with deep interest, I noticed a slight error in the formula for lamp resistance, viz.:

$$\text{Lamp } R = \frac{V}{C} = \frac{C \times V}{ab}.$$

This latter expression is wrong, inasmuch as

$$C \times V = \text{total watts} = ab \therefore \frac{C \times V}{ab} = 1.$$

But from definition

$$C = \frac{ab}{V} \text{ or } V = \frac{ab}{C}.$$

Therefore, formula should be:

$$\text{Lamp } R = \frac{V}{C} = \frac{V \times V}{ab} = \frac{V^2}{ab} \text{ or } = \frac{ab}{C \times C} = \frac{ab}{C^2}.$$

J. B. CAHOON.

LYNN, MASS.

A PROPOSAL TO POSTPONE THE STREET RAILWAY CONVENTION.

MY attention has been called to the fact of the opening exercises of the World's Columbian Exposition, which will be held on the 21st of October, and which is the last day of the meeting of the Street Railway Association.

It seems to me and to others with whom I have talked over the matter that it will cause confussion unless the date of the association meeting is changed. Members of the association from the West will undoubtedly want to attend the exercises, while the Eastern members, being in Cleveland, will no doubt feel disposed to attend such exercises.

The exercises in New York being held on the 11th, 12th, and 13th, it has occurred to me that it would be advisable to change the date of the convention meeting either to the first week of October, or the 18th, 19th and 20th, in which case the delegates could leave the night of the 20th and reach Chicago in time to attend such exercises.

Not being a member of the association, but simply a supply man, I trust you will pardon the liberty I take in calling your attention to the matter.

W. R. MASON, General Manager.

RAILWAY EQUIPMENT CO., CHICAGO, ILL., August 13, 1892.

A FRENCH PATENT ON VACUUM BULB LIGHTNING ARRESTERS.

REFERRING to your issue of July 20, I perceive that a correspondent wants information concerning existence of a vacuum bulb lightning arrester. For a reference for such construction let him consult French patent Bianchi, May 15, 1854, No. 19594. As this patent is not printed a copy will have to be obtained in Paris. It has good drawings and a full description.

A. M. TANNER.

NO. 7 RUE DU LOUVRE, PARIS, FRANCE, August 4, 1892.

Personal.

MR. W. R. MASON, general manager of the Railway Equipment Co., of Chicago, was in New York a few days ago. During his visit he gave several of his friends much pleasure by entertaining them at dinner. In a quiet room of the Holland he assembled the following guests: Mr. Geo. Flett, of the engineering firm of Dick, Kerr & Co., London, England; Mr. Chas. L. Pullman, Mr. John F. Barry, Mr. Thos. J. McTighe, Mr. Herbert L. Webb and Mr. Geo. M. Phelps. The dinner was excellent but not better than the ensuing three hours' chat. Electric railways, of course, were talked about, but not to the exclusion of much fun and many good stories.

MR. MORTON E. EDEN, who has recently returned to this country from Spain, where he had been engaged on some special construction work, has been appointed by Mr. A. E. Braddell, as assistant electrical inspector of the Underwriter's Association of the Middle Department, with his headquarters at 22 Clinton street, Newark. Mr. Braddell will continue to do his own part of the work from Philadelphia.

MR. H. L. WEBB left for London on August 17, with his wife, who has been an invalid for some time past, and who, it is hoped, will benefit by the change. Mr. Webb will attend to several professional matters while abroad, and his address for about two months to come will be the Institution of Electrical Engineers, London.

THE BOSTON WEST END STREET RAILWAY CO.'S ANNUAL REPORT.

THE annual report of the West End Co. just issued contains some very interesting figures It appears that the earnings have increased from $460,249 in July of 1887 to $596,157 in July, 1892, a result largely due to electric traction. By January, 1893, about 15,000,000 of miles run by its cars, or seven-eighths of the total will be electric. In 1888 the operating expenses, with horses, were 78.29 per cent.; in 1891 they were 74.48 per cent.

The subjoined table shows the progress of the electric system:

Horse cars.—Nine months.

	1891.	1892.
Miles run	9,615.736	7,258,689
Net earnings	$543,497.34	$367,036.68
Net earnings per car mile	5¾ cts.	5 cts.

Electric cars.—Nine months.

Miles run	3,491,231	5,477,571
Net earnings	$342,765.01	$810,024.00
Net earnings per car mile	10 cts.	15 cts.

Electric.—Three months.

	1891.	1892.
Total mileage	1.131,847	2,240,012
Total earnings	$432,947.70	$950,446 89
Net earnings	179,069.17	418,648.43
Net earnings per car mile	16 cts.	19 cts.

Estimated earnings of electric cars for current year.

	Nine months.	Three months. Estimated.	Total.
Total mileage	12,736,260	4,500,000	17,236,260
Electric mileage	5.477,571	3,000,000	8.477,571
Net earnings	$810,024	$570,000	$1,380,024
Net earnings per car mile	... .	....	16 cts.

The company is earning interest on its funded debt, 8 per cent. on the preferred stock, and 10 per cent. on all common stock outstanding. The fixed charges and dividends for 1892 amount to about $1,850,000.

A MEETING OF ELECTRICAL INSURANCE INSPECTORS.

A MEETING of electrical insurance inspectors was held in this city last week under the auspices of the Board of Fire Underwriters. Among those who attended the meeting were W. A. Anderson, A. E. von Giesen, A. E. Braddell, F. E. Cabot, W. H. Merrill, Jr., C. M. Goddard, M. E. Eden, A. B. James, W. McDevitt, Eaton, J. T. Ryan, C. L. Hedge, E. A. Fitzgerald, H. K. Miller, J. H. Washburn, Dr. W. Geyer, E. Leloup, W. Low.

The chief object of the meeting was the revision of rules, seeking to arrive at uniformity of practice among inspectors. Various questions were discussed, and after further decisions have been arrived at in later meetings, the rules will be published. From what transpired it would seem that wooden cleats have had their day. Steps were taken looking to the formation of an association of inspectors, a committee of which shall approve or reject proposed improvements and innovations. A lively discussion arose on the subject of interior conduiting and tubing for buildings, about which various opinions were expressed, the drift of which was that conduits were a decided step in the right direction but still open to improvement.

During the meeting a visit was made to the Edison station in Pearl street, where a series of tests was carried on of a remarkable new wire to be introduced by Washburn & Moen, and to which the name of "Salamander" has been applied. The tests were of a competitive nature, and went to show an extraordinary ability on the part of the wire to resist heat, fire and overload.

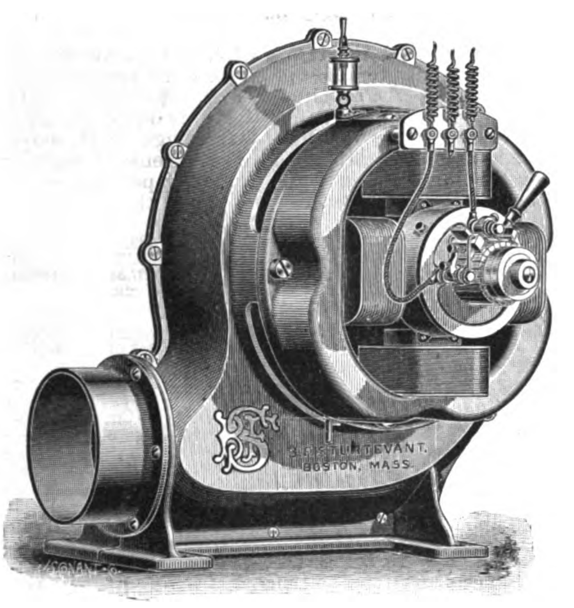
THE STURTEVANT ELECTRIC FAN.

THE rapid introduction of electricity as a motive power is continually making the convenience of the Sturtevant electric fans better appreciated. Nothing, it is claimed, can approach them in adaptability in all locations and to all classes of work for which they are specially designed. Neither engine nor belt is required, and starting and stopping is merely a matter of adjusting the switch. It can be readily seen that the fan can be set in any position without affecting the running of the motor. For this reason the fan may be located to discharge in exactly the required direction and connection easily made by pipe which can be made straight and direct to the point desired.

These fans are all of the standard high grade, and specially designed for the application of the electric motor. All running parts are carefully balanced, and designed for quiet running at a high speed.

The electric motor is of approved design, specially arranged for fan propulsion, and capable of extensive and continuous use without attention. It has been designed and is manufactured complete in every detail by the Sturtevant Co., and all parts are made on the interchangeable plan so that repairs can be executed quickly. The motors are wound for any voltage, and special designs will be brought out from time to time.

Obviously any type of fan can be fitted up in this way, and fans can be supplied for any conceivable purpose. For ventilation they are readily adaptable, particularly in the case where the introduction of an engine and boiler would be entirely out of the question. A mere connection of a wire to the power circuit does away with this and places the fan under immediate control. The high speed at which it is possible to run these fans gives them a large capacity, so that a small fan occupying but little space and easily located overhead can be used to ventilate apartments of considerable size. When run at a proper speed they are noiseless and there is no inconvenience whatever.


B. F. STURTEVANT.
BOSTON, MASS.

STURTEVANT ELECTRIC FAN.

In the dynamo-rooms of electric light plants they are naturally to be preferred for ventilation, while for ventilating dynamo, engine or other rooms on shipboard they have been largely introduced and found very efficient.

These motors fitted to the Sturtevant pressure and monogram blowers are being extensively introduced and found efficient for blowing forge, boiler and furnace fires of any description. Iron works of all descriptions find that this machine is particularly adapted to blow their forge fires or heating furnaces. Several have been introduced in malleable iron foundries, for which purpose they are particularly adapted. The Sturtevant Co. have contracts now in hand for a number of electric fans for the above use.

A notable example of a very complete plant is the contract which the Sturtevant Co. have taken for blowers and exhaust fans for the new blacksmith shop and foundry at the Pennsylvania State College, State College, Penn., in their new engineering building. The Sturtevant forges with special exhaust fan driven with electric motor are to be used in the blacksmith shop, and the blast for these forges is to be supplied by the Sturtevant electric pressure blower, and the blast for the copula furnace will be supplied by another Sturtevant electric fan. It is seen that this company has facilities for furnishing a plant of this kind complete, including forges, blowers, exhaust fans and electric motors, together with a complete system of blast piping for supplying the forges and furnaces with air blast, and suction piping for taking away the smoke from the fires. Everything is installed complete ready for the electric wiring.

When contracts of a similar nature are to be placed it is claimed that purchasers can save money and a great deal of trouble by availing themselves of the extensive experience of this company in the suitable placing and erection of fan plants, complete with electric motors specially designed for each and every case and guaranteed throughout.

The B. F. Sturtevant Co., Boston, Mass., will be pleased to recommend the proper size of fans and to furnish them with motors for any voltage with plans for installation.

THE ELECTRIC RAILWAY ON THE MADISON SQUARE TOWER.

ONE of the most interesting features of the electrical work at the Madison Square Garden Tower is the electric railway at the fifth loggia. In some respects it may be considered the highest electric road in the world.

The railway was conceived by Mr. Stanford White, of the well-known firm of McKim, Mead & White, who are architects of the garden, to carry the projector, built by the General Electric Company, around the tower.

The projector consists of a mortar-shaped band mounted on a standard built of sheet iron and insulated from the base by a large wooden gasket. To supply current to the lamp, heavy mains are run from the dynamo-room to the tower. One wire of the same polarity as the neutral of the street service is connected directly to the rails. The other, after being intercepted at the second loggia by a rheostat, is connected to a strip of copper which is fastened to the inner circumference of a large insulated support, placed between the rails. The construction of this support is such that a good promenade is made around the tower.

Current is taken from this conductor by means of a heavy brush, fastened to an insulating arm, and kept in firm contact on every portion of the circuit. The arrangement of the carbons, and mechanism for regulating them, is of the finest and most sensitive nature conceivable. On the top of the lamp just above the carbons is placed a box containing the motor and relay, the latter capable of reversing the motor, with a sensitiveness of a fraction of a volt.

The mechanical operation of the carbons is as follows: A right and left threaded shaft, to which the carbons are connected by adjustable nuts; the difference in the pitch of the two screws is calculated to be proportional to the difference of the consumption of the carbons; and a tangent screw which operates the shaft by means of the small motor.

The electrical operation is effected by the use of a relay which is a shunt from the two carbons, so that when the arc becomes greater its resistance as compared with the relay is greater, and the latter is allowed to act and switches the motor so as to feed the carbons together and consequently reduce the resistance of the arc till they rest at a point of equilibrium which is regulated according to the size and density of the carbons and the amount of current given the lamp. The motor is differentially wound so as to avoid sparking of the relay armature in changing the contacts.

In the rear of the projector is placed a reflector of the Mangin type, specially imported for this installation. In its centre is fastened a crystal prism which transfers the image of the carbon points to a little ground glass plate at the side of the projector, similar to the inverted image of a camera focusing glass. This arrangement is indispensable to the operator who can at all times view his arc without the blinding rays of the direct light. Another good feature consists in the glass being a gauge as regards the focus of the reflector and with its aid and the adjusting screw at the base of the lamp, a perfect centre is at all times maintained. In the Edison projector, an alternative is taken from the general construction of focusing lamps of this kind Instead of adjusting the carbons to the reflector, it is vice versa, and a beam of varying intensities and magnitudes may be attained by the use of the hand wheel at the back of the lamp.

In setting the carbons great care is taken to keep them in perfect alignment in one direction and to place the positive carbon a little in advance of the negative in the other, so that the crater on the former may in itself act as a reflector to throw the otherwise diverging rays directly into the larger reflector. To aid this and to concentrate the heat at the arc, a hemispherical crucible is fastened to the carbon frame and is lined with a refractory material.

To supply current to the motor for propelling the car, and also the smaller motor which feeds the carbons, both of which are wound for a higher potential than the lamp requires, a special trolley wire is suspended from the iron railing on the side, by porcelain insulators. Bearing on the lower surface of the wire is a brush which is connected down the trolley to the two motors respectively.

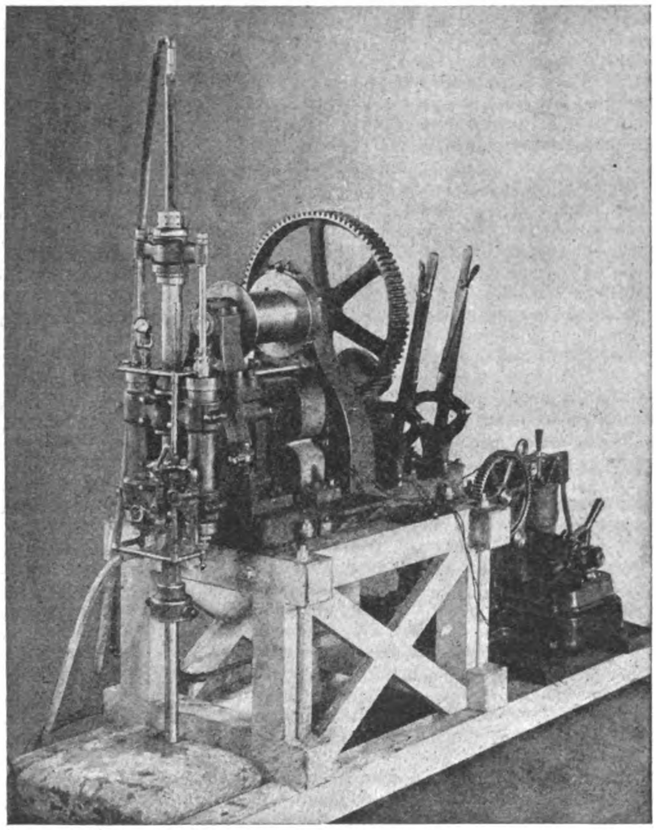
One of the Crocker-Wheeler motors was selected to propel the car, which is also furnished with a Crocker-Wheeler reversible regulator, so as to place the whole in perfect control of the operator. An insulated tangent screw is connected to the motor shaft, thus reducing the speed to a maximum of 15 revolutions per minute, it being thought that a greater speed than that would be dangerous in case of any carelessness of the operator.

The projector carriage was especially designed for the purpose by Mr. John Van Vleck, of the Edison Electric Illuminating Company, of New York, and his assistant, Mr. Wm. Erickson, whose method of installation of the insulated support for the central conductor has given a surprisingly high insulation test under very unfavorable conditions of the weather.

At a pressure of about 45 volts, the lamp will operate with the best results with 50 amperes of current, which is about $2\frac{1}{4}$ kilowatts, to produce a light which will enable one to plainly distinguish objects at a distance of over three miles. Such statements will show the whole installation to be rather an economical advertisement, and doubtless will be taken up by many architects in designing pleasure resorts of this kind.

THE GENERAL ELECTRIC DIAMOND DRILL.

The application of electricity in mining operations has caused in recent years the evolution of many new and perfected pieces of apparatus. One of the most important of these, the drill, has formed the subject of long and special attention on the part of electricians and mining engineers for a considerable time past, on account of its almost universal use in the mining industry. The General Electric Company has just perfected a new diamond drilling machine for which are claimed many points of superiority.



General Electric Diamond Drill.

The drilling apparatus is shown in the illustration mounted upon a heavy timber frame. Behind this is the electric pump supplying water to the drill and having a capacity about 700 gallons per hour against a pressure of 150 pounds to the square inch. It also supplies water to the hydraulic cylinders of the drill as well as the drill rod. Valves are set in the pipes leading to the pressure cylinder so that any desired pressure may be put upon the drill bit. A valve also controls the supply of water to the drill rod, the pump being able to supply an ample amount to keep the cutting rim of the bit perfectly free and clean. The drill head is arranged with a heavy hinge so that when uncoupled from the drill rod, it may be swung away from the frame, and allow room for hoisting the drill rods from the hole. At the top of the main standards of the iron frame is arranged a small hoisting drum, which, by the simple movement of a lever is geared to the armature of the motor, and the machine is ready, with the aid of a block and fall, to hoist out its own drill rods. In the experiments which were made with one of these drills at the factory, the drill under pressure of 120 pounds per square inch on the pistons of the pressure cylinders bored through twelve inches of solid granite in three minutes. Under a pressure of 75 pounds the drill cut through twelve inches in six minutes, and at a pressure of 35 pounds it cut through the same amount in about sixteen minutes. These cutting speeds were made with the drill bit and short barrel coupled directly to the drill head, and will necessarily be slightly dimished when a considerable length of rod has been driven into the rock, but they are sufficiently conclusive to show that the even motion of the electric motor makes it the ideal power for this work. The satisfactory performance of the drill apparatus under the stringency of the different tests to which it was subjected should lead to its wide adoption in the mining world.

THE ENTERPRISE ELECTRIC CO.

The above company, of 313–315 Dearborn street, Chicago, report that business is on the increase, surpassing even their fondest expectations. During the past week they have opened a branch house at No. 15 North Ninth street, St. Louis, Mo., with Mr. Will H. Ferris, formerly with their company in Chicago, as manager. Pres. W. C. McKinlock, of the Enterprise Electric Co., has been in St. Louis perfecting arrangements, and they will be ready for business there at once.

The National India-Rubber Co.'s wire, manufactured at Bristol, R. I., and for which the Enterprise Co. were recently appointed general Western agents, is being well and favorably received by the trade, and it is only a question of a very short time when its excellent insulating qualities (whereby it is rendered non-susceptible to the destructive influence of heat, cold, moisture and gases), will be recognized and appreciated by the trade throughout the West and Northwest.

STORAGE BATTERY CAR COAL CONSUMPTION.

The following is a very interesting letter, as bearing upon the question of storage battery car operation:

Washington Park Street Railway,
Sioux City, Ia., Aug. 12, 1892.

G. M. Dunbar,
General Manager B. and S. Storage Battery Co., City.

Dear Sir—Below you will please find the cost per car mile of coal consumption used in generating electricity for charging Bradbury-Stone Storage Batteries in use on the car now operating on the Washington Park car line in this city. The record is not the result of a single trip, or day's run, but is verified by daily operations. At the end of each run of $25\frac{34}{100}$ miles the batteries are changed; this distance including all stops and a wait at each end of the line, being covered in three hours and thirty-eight minutes. For this run of $25\frac{34}{100}$ miles we consume two hundred and forty pounds of slack coal, costing $1.52 per ton, being eighteen and a quarter cents, or a fraction less than three-quarters of one cent per car mile.

Very truly yours,
(Signed) Ed. Hankinson,
President.

ELECTRIC RAILROAD WORK IN PHILADELPHIA.

The Philadelphia Traction Company has contracted with the Westinghouse Electric Company for the motors and generators for all of the lines which the company intends to equip with electricity. The only line affected at the present time is that on Catharine and Bainbridge streets.

The contract fixes the price for the different sizes of motors which the Traction Company will require, and virtually gives the Westinghouse Company the contract for all the motors that will be needed to equip all of the Traction lines with electricity. As about 1,000 cars will be needed in all, the transaction involves about $1,500,000.

Twenty-one cars will be put on the Catharine and Bainbridge streets line. They are being built by the J. G. Brill Company, of West Philadelphia. The cars will be handsome, and larger than the ordinary street car. Each car will be equipped with two 20 h. p. motors, which will be ample power to propel the car and a trailer, both filled with passengers. The Westinghouse Company will furnish with the motors the other necessary electrical equipment for each car. Two generators, to begin with, will be furnished by the Westinghouse Company, of 250 h. p. each. They will be driven by two 250 h. p. Corliss engines, for which the Wetherills, of Chester, have the contract.

The Field Engineering Company, of New York, has the contract for the street equipment of the Catharine and Bainbridge street lines and work is to begin at once. New rails are to be laid and the very best material used. It is expected that the electric cars will be running by October 1.

TRADE NOTES AND NOVELTIES

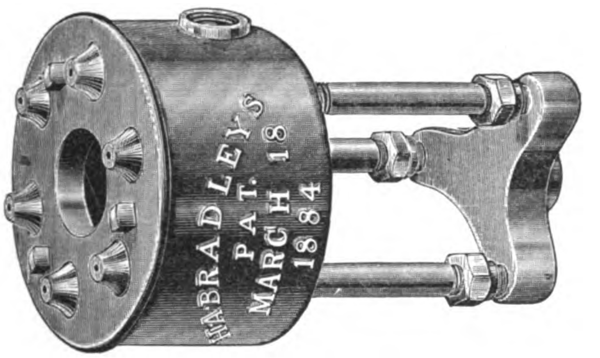
AND MECHANICAL DEPARTMENT.

No wideawake merchant will allow the exploded theory that August advertising is not productive of results, to interfere with his summer trade hereafter. —N. Y. Times.

THE BRADLEY HYDROCARBON BURNER.

THE Bradley gas generator, shown in the accompanying illustration, is a device due to the inventive skill of Mr. Henry A. Bradley, of this city, for the instantaneous and continuous conversion of crude and refuse oils or coal dust into a gas of high heating and illuminating power. Instead of volatilizing and burning the liquid fuel, as is frequently the case in oil burners, the Bradley generator changes the chemical composition of the fuel by introducing steam into a mixing chamber within the apparatus, which at the same time is maintained at a high temperature. A hydrocarbon gas is thus formed which may be stored or used immediately, as desired. The device may be applied to any furnace or retort without drawing the fire, and is claimed to produce gas at half the cost of any other method.

The operation is exceedingly simple. The cylinder of the apparatus is divided into two compartments, into the outer of which oil is introduced by means of the tubes seen in the illustration. Steam is then admitted through an opening in the side to an inner compartment. From this steam chamber project nipples corresponding with, and extending part way into, those from the oil chamber seen at the end of the cylinder. The steam issuing from these openings produces a partial vacuum and draws the oil after it, and at the same time the heat changes the chemical composition of the mixture and produces a rich hydrocarbon gas. The heaviest grade of oil can be used in this apparatus. This oil contains about double the heating and illuminating power of naphtha and costs about one-half as much.



BRADLEY HYDROCARBON BURNER.

As an instance of the readiness with which this burner may be installed, may be cited the case of a New Jersey gas company. One Bradley generator has been placed just within the door of the fire-box, and takes steam from the boiler, while a tank of oil stands at one side and feeds the generator as required. The gas from this is burned immediately and takes the place of the coal fire, supplying heat to six other generators whose output is led to the retort and finally to the gasometer for general use.

Coal dust has also been successfully burned in this apparatus. Inquiries in regard to further particulars may be addressed to the Bradley Gas Generator, care of this office.

THE PACKARD LAMP IN CANADA.

THE PACKARD LAMP COMPANY, Limited, of Montreal, have, for some time past, been quietly engaged in fitting up a commodious factory, Nos. 96 to 100 King street, Montreal, Canada, with the most improved machinery for the manufacture of incandescent lamps. The equipment of the factory is now complete, and the company are making incandescent lamps in all their details, of any candle power, adapted to any base and voltage, which they are prepared to supply to the Canadian trade. These lamps are the latest improved and well-known "Packard High Grade" in all respects similar to those manufactured by the New York and Ohio Company, at Warren, Ohio.

The new company are very fortunate in having their factory under the personal management of Mr. J. W. Packard, with Mr. F. E. Cavanaugh as superintendent; and, with the additional advantage of the established reputation of the Packard lamp, they should be able to command an extensive trade in Canada.

IMPROVEMENT IN STEAM SEPARATORS—THE STRATTON SEPARATOR.

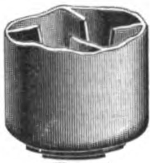


FIG. 1.

WITH the constant and growing demand among engineers for *dry steam* in connection with all power plants, the inventive genius of the engineer has kept pace in providing separators of various designs and merit that may be connected into the main steam pipe going to the engine for the purpose of separating the water, oil or dirt from the steam, so that dry steam free from foreign substances may be supplied to the engine.

Among the various appliances for the purpose stated above, that manufactured by the Stratton Separator Company, 32 Cortlandt street, New York, has won for itself a high place in the estimation of engineers throughout the country that could only be obtained by the real and undoubted merit of the apparatus.

The Stratton separator is based upon the principle that if a rotative motion is imparted to the steam as it enters the separator, all the liquid particles it may contain, being heavier than the steam, acquire centrifugal force and are projected to the outside of the current.

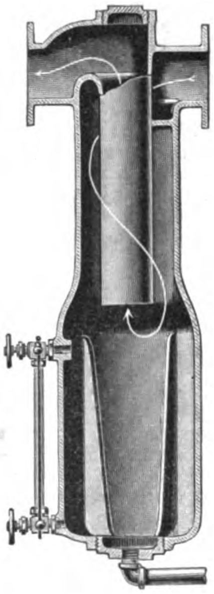


FIG. 2.

Practical results have, it is claimed, proven this theory to be correct, but in some cases where high pressures of steam are used, it was found that the water gauge on the side of the separator would show "full of water," while steam would blow out of the drain pipe at the bottom. While this clearly proves the centrifugal principle of the separator, the force was so great as to hold about the interior walls of chamber a volume of water whirling so rapidly as to be hollow in the centre, allowing steam to blow out of the drain pipe.

To meet this slight objection, the Stratton Company have patented an improvement, as shown in the accompanying cuts, and briefly described as being a centrifugal steam separator provided with wings or plates projecting from the interior surface of the well chamber at an acute angle therewith, and to the course of steam or water thus breaking the whirling body of water and allowing it to settle quietly in bottom of separator chamber from whence it can be drained.

Fig. 2 of above illustrations shows a horizonal view of the separator in section, and Fig. 1 a cross-section of the water chamber showing wings or plates placed at an acute angle to current of the water as described.

The Stratton separator, long favorably known, has gained greatly by the improvement as explained and illustrated above, making it to-day, the makers believe, without question the best and most efficient apparatus yet devised for extracting all entrained water so that *steam absolutely dry* may be supplied to the engine.

THE ELECTRICAL EQUIPMENT CO.

THE above company of Detroit, Mich., J. J. McKenna, general manager, has contracted with A. Saks & Co., of Washington, D. C., to place about 800 lights in front of their building as a special decoration for the approaching Grand Army of the Republic encampment. The contract was secured by the Electrical Equipment Co. on account of its success in decorating the city hall of Detroit for the municipal authorities, last year. The company now have ten men at work preparing special emblems and devices for these decorations.

The equipment Co. has also awarded the contract for wiring the largest private residence in the State of Michigan, that of Mr. David Whitney, Jr. There will be over 1,000 lights in the building, and one of the principal features worthy of note is that there will be no gas piping, and that sole dependence will be placed on electricity.

THE AMERICAN ELECTRO-ENAMELITE CO.

THE above corporation has been formed at Chicago with a capital stock of $250,000, in shares of $100, to make, sell and lease electric heating apparatus and enameled conductors. Among the officers and stockholders are such well-known men as George Cutter, B. E. Sunny, J. S. Cummins, O. H. Olson and Jesse Scribner. It is understood that Mr. Cutter claims a prior and controlling patent on enamel heaters and conductors and that he intends pushing his invention through this new company.

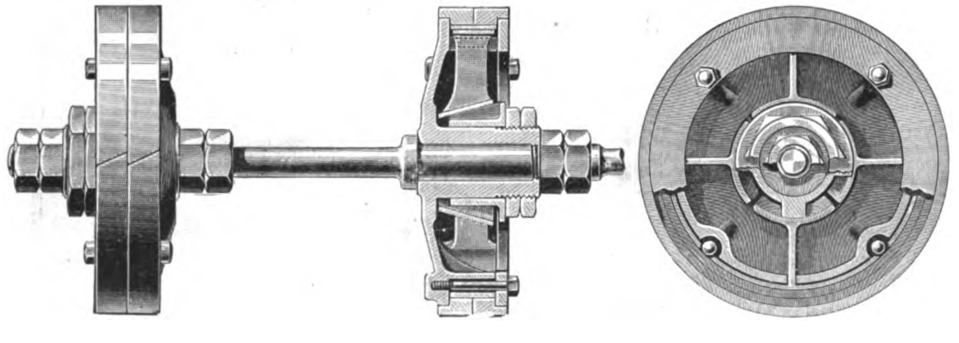
THE HERSHEY ADJUSTABLE PISTON VALVE.

A LARGE experience with piston valves has led to some improvements for which there has recently been granted a patent, covering some of the most essential features in the make-up of a thoroughly practical adjustable piston valve, of any size, limited only by considerations other than its mechanical construction.

These valves have been placed in a number of Ide and Ideal engines of various sizes, manufactured by the Harrisburg Foundry and Machine Works, with the most satisfactory results, the valves ranging in diameter from 6 to 18 inches, in simple and compound engines, under high and low steam pressure, establishing the fact that with ordinary machine-shop appliances, and this form of construction, the highest degree of accuracy and efficiency is obtained, and those conditions readily maintained.

The piston valve has so many practical and commendable qualities that its use is preferred by some of the best engineers to any of the well-known types of balanced valves, especially as applied to marine engines. A solid and chilled piston valve, working in hard cages, all accurately ground, makes an excellent valve, and is entirely practicable in very small sizes, but for the larger diameters it becomes impracticable and dangerous. Assuming, of course, that the valve should be absolutely steam-tight, the necessary close fit to make it tight under high pressures will cause it to stick either when the engine is at rest or under steam, occasionally stripping all connections from valve to eccentric.

To obviate this difficulty, Mr. M. E. Hershey, of the Harrisburg Foundry and Machine Works, Harrisburg, Pa., has designed the valve shown in the accompanying illustration. The primary object of this improved construction is to provide a piston valve which shall be capable of rigid adjustment to compensate for wear, so that the adjustment is maintained throughout the stroke of the valve and while subjected to peripheral pressure in passing over the ports, and which, when the parts are cooled, will contract and prevent sticking or injury to wearing surfaces, as for instance, when the engine is started after a period of rest.



HERSHEY ADJUSTABLE PISTON VALVE.

To accomplish this purpose an adjustable sectional spider is introduced of composition metal or brass, having a greater range of expansion than the metal in the valve proper or its seat. Live steam is admitted between the valve discs and the adjustment made when hot, the normal working condition. When steam is stopped off from the valve and the parts cool, the sectional brass spider contracts to a greater extent than the rest of surrounding metals, and releases the packing rings, leaving them entirely free in their seats. When steam is admitted, the expansion of the spider being proportionately greater, the valves necessarily quickly assume their original adjustment. It is the employment of the metals of varying expansibility that makes the positive valve adjustment practicable. The brass spider, having the greater range of expansion, is so constructed as to be most susceptible to the change of temperature.

By reference to the illustration it will be observed that the peripheral adjustment to compensate for wear does not affect any other adjustments for steam distribution.

ON "AMERICA'S GREATEST RAILROAD."

A PROFUSELY illustrated volume of 392 pages, exclusive of maps, is the latest addition to the literature of the New York Central and Hudson River Railroad. The work contains an enormous amount of cleverly condensed information relative to the cities and resorts on the line of the road and its branches, as well as a list of hotels and a score of minor details. The Adirondack region especially is described by one who knows, and the illustrations, many of which are reproduced directly from photographs, bring back the scent of the woods and the tingle of the crisp mountain air.

By way of frontispiece, is a large folding map of the region of the Great Lakes, showing the entire road together with its connections and dependencies from New York to St. Louis.

A NEW STATION FOR ST. JOHNS, NEWFOUNDLAND.

THE ST. JOHNS ELECTRIC LIGHT CO., of St. Johns, Newfoundland, whose station was completely wiped out at the recent conflagration, have now nearly completed a new brick station on a much larger scale than their old one. This is being equipped by John Starr, Son & Co. Ltd., of Halifax, N. S., with two Leonard-Ball compound engines of 100 h. p. each, two 50-light arc dynamos and one 1.200-light alternating incandescent dynamo, made by the Royal Electric Co., Montreal.

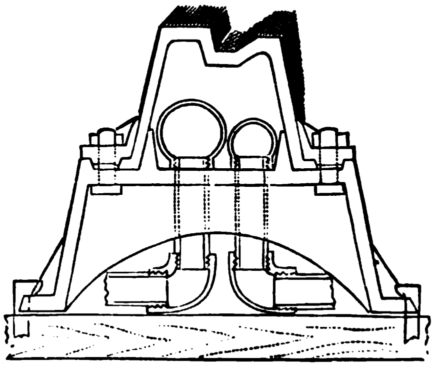
An incandescent plant of the Lahmeyer system has been installed by Messrs. Starr in the machine shops of James Angel & Co. and they have contracted for another of the same system for the new bakery establishment now being built by Messrs. A. J. Harvey & Co. St. Johns will soon rise from its ashes a finer and more modern city than before.

THE WRIGHT RAIL AND CHAIR FOR ELECTRIC RAILWAYS.

THE accompanying illustration shows a new form of rail and chair for electric railway use, devised by Mr. W. H. Wright, of Buffalo, N. Y. This rail is especially adapted to the induction system, although its use is not by any means confined to that system alone.

The two tubes under one of the tracks, shown in the engraving, carry the feed wires, and the power reaches the wheels and the motors through the tracks, coming back through the others to form the circuit.

A company is being formed for the manufacture of the rails, and it is stated that a syndicate of Grand Island property owners have offered a river frontage for a large plant They have offered as an inducement for the company to locate there the necessary land, and will build dock, carry electric cable from the Niagara Falls Tunnel Power Co. to the grounds and will pipe natural gas for the furnaces.



WRIGHT RAIL AND CHAIR.

AN ELECTRIC RAILWAY DEAL AT TROY, N. Y.

THERE are rumors of all sorts in connection with the Troy and Lansingburgh Railway stock, and as yet nothing positive can be stated, writes our Troy correspondent, except the fact that Clark, Dodge & Co., of New York, have been acting for a syndicate of capitalists (names and addresses not given) who offer to take the entire stock of the company on the basis of $225 for each two shares. As each share is of $50 par value, this amount represents, therefore, $225 for each $100 in stock.

It is stated, this week, that the sale is virtually by the company to itself, and that signatures have been obtained for all but 750 shares.

The deal is said to include also a consolidation of the Troy City Railway Co, bringing both companies under one management, but so far nothing definite has been learned, pointing towards such an event.

BIDS FOR AN ELECTRIC PLANT WANTED AT ELKTON, MD.

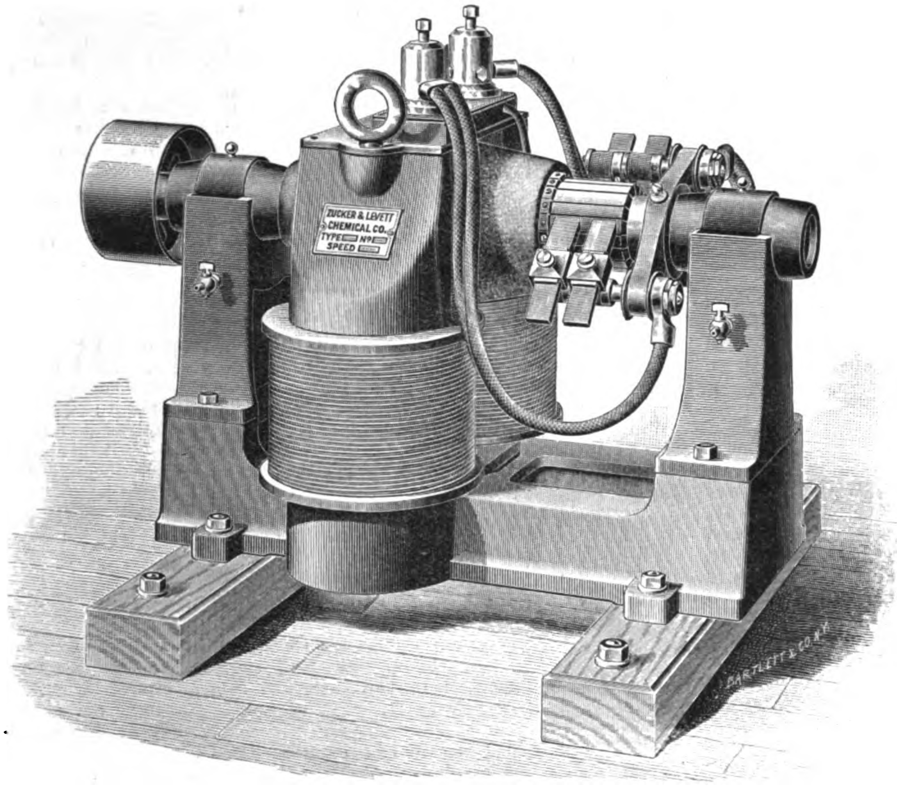
SPECIFICATIONS for electrical apparatus, poles, wiring, lamps, boiler and boiler setting, steam pump and injector, automatic cut-off, steam engine and connections to boiler, and for a power house for the Elkton Electric Light and Power Company are now ready and can be seen at Elkton, Md., in possession of Chas. R. Maxwell, secretary. Sealed proposals will be received at the secretary's office up to September 5, 1892, at 7:30 p. m., for furnishing the above supplies and placing them for use. The company reserves the right to reject any or all bids.

THE NEW IMPROVED AMERICAN GIANT PLATING DYNAMO.

THE accompanying cut illustrates the "New Improved American Giant" dynamo for electroplating and electrotyping, which is placed upon the market by the Zucker and Levett Chemical Co. of this city, and designed by their electrician, Mr. M. Mayer.

The machine is of the inverted horseshoe type, having a laminated field in the smaller, and a special cast iron equal to wrought iron, in the larger sizes. There is also a groove on the end of the bearing shell which prevents the well-known slinging of the oil. The field coils are separately wound on brass spools and are interchangeable. The armature, which is of the modified "Siemens" type, is large in diameter, having very few turns and a large number of sections. The windings of the armature consist of a large number of wires connected in parallel, thus preventing the generation of "Foucault" currents in the coils themselves, and facilitating the winding. The magnetism of the field is very powerful in proportion to the armature, thus preventing all sparking and insuring good regulation.

The machine is practically self-regulating, that is, the voltage is practically the same, whether one or the total number of articles are in the bath; also, the power consumed is exactly in proportion to the load, a very important factor if the coal bill is taken into consideration. The efficiency of the machines is also very high, varying from 75 to 90 per cent according to the size of the machine. The machines are shunt wound, and reversing is impossible. The mechanical details of the machines are very carefully worked out and the workmanship is of the very best. The shafts are short and very large in diameter. The bearings are long in proportion to the diameter and are made of phosphor bronze. The commutators, which are made out of drop-forged copper, are perfectly insulated with mica, and baked to prevent short-circuiting of the strips.



AMERICAN GIANT PLATING DYNAMO.

The brush holders are of an improved pattern and are adjustable in every respect. The brushes can be lifted off the commutator by means of a spring catch provided for this purpose. All other parts are made to standard gauges and are interchangeable.

A large number of these machines have been in use for some time under the most severe tests. They have proven to be most durable and highly efficient machines. There is absolutely no sparking, excessive heating or wear at the commutator or brushes, features which will surely be welcomed by users of plating dynamos.

AT the Troy, N. Y., electric light station, work has been begun on the foundations for the new 500 h. p. engine.

ELECTRIC LAUNCHES FOR THE WORLD'S FAIR.

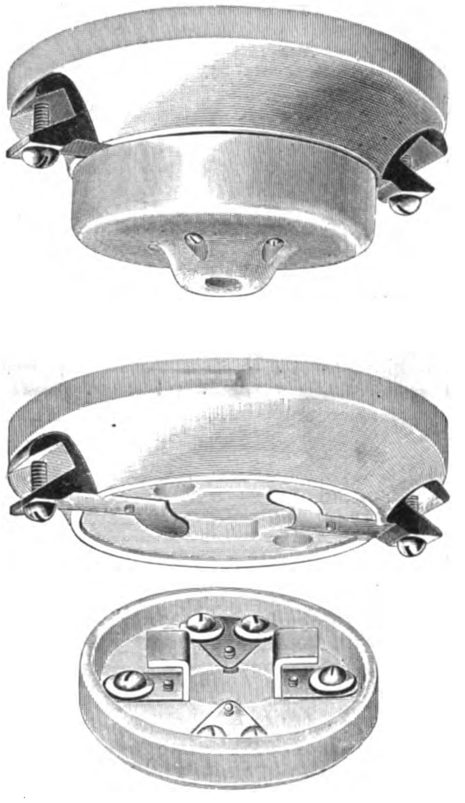
THE ELECTRIC LAUNCH AND NAVIGATION COMPANY of New York, has been awarded the contract for running electric boats on the interior waterways at Jackson Park during the World's Fair. It will pay the Exposition 33⅓ per cent. of the gross receipts. These boats will convey visitors from one point to another or on a general three-mile tour of the grounds, as desired. Such a tour affords some of the finest views of the buildings and grounds, and is sure to be popular.

THE BALL & WOOD CO.

THE BALL & WOOD COMPANY of No. 15 Cortlandt street, New York, are crowding their works night and day to fill their orders, and among the more recent contracts closed was one for two of their large tandem compound engines for Bethlehem, Pa.

THE "IONA" CEILING CUT-OUT.

WE illustrate herewith a new design of ceiling cut-out, the Iona, which is meeting with marked favor among electric light men. As will be seen from the cut, the cap which holds the fuse is fastened to the base by a long clip interlocking with the V-piece of the cap; but this is further fastened by a phosphor bronze spring, making a connection absolutely positive and secure, while obviating the inconvenience of screws. This cut-out is being placed on the market by the Redding Electric Co., 41 Federal street, Boston.



"IONA" CEILING CUT-OUT.

A $35,000,000 CENTRAL STATION.

THE INTERNATIONAL ELECTRIC LIGHT CO., now in process of formation, propose to utilize the power of the Niagara River above the falls to furnish current to all the principal cities in the United States and Canada. The prospectus of the company states that the central station will be three times as large as any other building in the world, and will cost about $35,000,000.

THE RIES REGULATING SOCKET.

A LITTLE pamphlet, whose cover is resplendent with the national colors and the representation of a Ries regulating socket and lamp in silver, has been issued by the Ries Electric Specialty Co., of Baltimore. The pamphlet contains eight pages of reading matter calling attention to the various advantages of this socket and giving reasons why it should be adopted wherever the alternating current is used.

NEW YORK NOTES.

The Short Electric Railway Co. through their general Eastern agent, Mr. Edward J. Wessels, have just closed contracts for a 183 h. p. generator and four 30 h. p. single-reduction motors for the Syracuse, Eastwood Heights & DeWitt Railroad Co., of Syracuse, and also a double equipment of 20 h. p motors for the Hartford & Wethersfield Horse Railway Co , Hartford, Conn.; also seven double equipments of 20 h. p. single-reduction motors for the Trenton Passenger Railway Co., Consolidated, Trenton, N. J. This last is an additional order as the company has equipped its entire line with Short generators and motors and gave this additional order after finding how satisfactorily the apparatus worked.

The Havemeyer Building, which is the handsomest office building now being erected in New York City, is going to be equipped electrically in the most perfect manner. It will have an installation of over 3,000 incandescent lamps. The wiring will be done in interior conduits throughout, and the generating plant will be of the most modern type, the dynamos being directly coupled upon the shaft of the engine. The contract for the entire electrical equipment has been awarded to H. Ward Leonard & Co.

The Edison Electric Illuminating Co., of Brooklyn, have decided to build a new plant, and have adopted the plans of the Berlin Iron Bridge Co., of East Berlin, Conn. The building will be 74 feet wide by 100 feet long with brick wall, the roof being the Berlin Company's well-known patent anti-condensation corrugated iron construction. The floor space will be controlled by a traveling crane having a capacity of eight tons, which crane will also be furnished by the Berlin Company.

Mr Avery P. Eckert, of 203 Broadway, has returned from a highly satisfactory business trip through Canada, New England, New York and Pensylvania, in the interests of Kerite. He reports the outlook as bright. While in Ottawa, Mr. Eckert saw some Kerite wire that has been exposed to all the variations of temperature for the past twelve years and is still giving good service.

A. M. Mason is carrying on at 366 Myrtle avenue, Brooklyn, the battery, motor and medical supply business established by James H. Mason. The concern has just issued a neat and useful pamphlet devoted to the Mason specialties. It can be had, with cash discount sheet, on application.

NEW ENGLAND NOTES.

Mr. R B. Pierpont, formerly manager of the Chicago branch office of the Gould-Watson Company, has resigned his position, and has formed a co-partnership with Mr. James W. Longstreet, under the firm name of Longstreet, Pierpont and Company, with offices in the Exchange Building, 53 State street, Boston. The new firm in addition to the transaction of a general banking and brokerage business, will make a specialty of handling electric street railway and electric lighting securities and municipal bonds, and are prepared at any and all times to purchase first-class securities, and will be glad to communicate with companies contemplating the issue of bonds. Mr. Pierpont needs no introduction to the electrical trade, having been connected with that business for a number of years, and it is needless to say, has made in that time many friends who wish him success in his new venture. Mr. Longstreet has for many years been connected with the banking and brokerage business. He is the nephew of D. F. Longstreet, formerly general manager of the West End Street Railway Company, of Boston, and is well known in railway circles. The new firm will be pleased to have any of their friends make their headquarters with them while in the city, and will be glad to extend any courtesy in their power.

Waterhouse Brothers, of Hartford, Conn., are issuing one of the most tastefully designed pamphlets ever gotten up, to show the construction of their arc lamps for either arc or incandescent circuits. The cover is of plain white paper, with a heavily embossed cut of the lamp, in black, gold and silver, which gives it an extremely handsome appearance. The cuts in the inside of the book show the details of the construction of the lamp, and point out well the numerous valuable features which the lamp possesses.

The Pettingell-Andrews Company, of Boston, are issuing a large number of the new catalogues of the Bryant Electric Company, of Bridgeport, for which company they are agents in New England. The new catalogue is very handsomely gotten up, and comprises cuts of every kind of single and double pole switch, plain and ornamental, sockets, rosettes, cut-outs and other useful novelties. The book is well worth having and will be found useful.

WESTERN NOTES.

Clark & Marshall are in communication with several Eastern firms for the Western agency for several good specialties which they will soon have on the Western market.

The American Manufacturing & Engineering Co. are to be congratulated on securing the agency for the Hewett oil insulator, which was described and illustrated in The Electrical Engineer of March 30 and May 18. Their rights cover all territory east of the Alleghanies. Recent tests have proven the Hewett Insulator to be all that is claimed for it. Information regarding this radical departure in insulators is cheerfully given on application to the company.

South Pittsburg, Tenn.—The South Pittsburg Electric Light & Power Co. is doing a good business despite the recent depression in Southern trade and industry, and has declared a semi-annual dividend of 5 per cent. payable at once. Geo. E. Downing is president; J. C. Beene, vice-president; W. B. Garrett, secretary and treasurer, and W. N. Shelley, electrician.

The Enterprise Electric Co., No. 313-315 Dearborn street, Chicago, have just been appointed Western agents for the Holtzer-Cabot fan motors. These machines are some of the handsomest ever put on the market, and are meeting with the same favor in the West that has already been accorded them in the East.

Mr. E. R. Crolius, who is well known in electrical circles throughout the West from his connection with the supply and fixture trades, has associated himself with the Chicago Electrical Manufacturing Co., as their manager, and will be pleased to see his friends at Nos. 73–75 West Jackson street, Chicago.

The Buckeye Electric Co. report that their business is increasing to such an extent that they are putting on additional help as fast as it can be secured. The Western States contributed some large orders during the past week. Their coiled filament lamp is meeting with great favor.

The Hall Signal Co. will use 125 miles of Simplex wire for their block signals on the Illinois Central Railroad at Chicago. This, together with the 270 miles used for the same purpose on the Chicago and Northwestern Railroad signals, a point for Simplex.

Mr. Lucius T. Gibbs, consulting engineer to the Pabst Brewing Co., of Milwaukee, has recently closed a contract with the Siemens & Halske Co. for two 2,500-light dynamos and one 1,000-light dynamo. These are to be run by Lake Erie engines.

PHILADELPHIA NOTES.

The La Roche Electric Works are very busy on several very large orders for both arc and incandescent plants. They report the following recent sales in this city: Standard Theatre, 500-light plant; Standard Iron Foundry, 500-light plant; Moore's Windsor Hotel, 100 light plant; J. and G. Rich, 75-light dynamo; R. H. Miller, 50-light dynamo; N. S. Miller, 30-light dynamo; Star Electrix Co., 100-light alternator; Richard Hay & Sons, 100-light dynamo; Falwell Bros. & Co., 100 light plant. They have also sold plants and apparatus to the following out-of-town parties: I. S. Champion, Ocean City, N. J.; Wm. Hallowell, Hatborough, Pa.; Crescent Paper Co., Marsailles Ill.; James McGrew, Chicago; Lake Bluff Hotel, Lake Bluff, Ill.; Vienna Cafe Co , Chicago, and Charles C. Lockstaldt, Chicago.

Pepper & Register.—The above firm of electrical and mechanical engineers, Provident Building, Philadelphia, have secured the contract to build the Easton, South Easton and Phillipsburg Electric Railway, now consolidated, and called the Easton Transit Co. Work will begin not later than September 10, and is to be completed by Thanksgiving Day.

Messrs. Wright & Starr have contracted to furnish William Sellers & Co. with twenty Waddell-Entz motors ranging in size from 5 to 40 h. p. Most of these motors will be used in operating traveling cranes, of which this company make a specialty.

The Pennsylvania Electric Engineering Co. have the contract for equipping a trolley system for electric cranes for the Midvale Steel Company, and are doing all the wiring about their buildings.

CANADIAN NOTES.

Messrs. H. P. Dwight, the president, and G. D. Perry, the secretary of the Great Northwestern Telegraph Co.; F. H. Waycott, the manager of the Anglo-American Telegraph Co.; Wm. Wainwright and F. Roper have given notice to the Quebec Legislature of application for incorporation under the name of the Anglo-Provincial Telegraph Co., with a capital of $25,000. This company will carry on a general telegraph business in the province of Quebec, with headquarters at Montreal.

A factory is being fitted up at Ottawa, Canada, for the manufacture of the Beacon incandescent lamp.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.
VOL. XIV. AUGUST 31, 1892. No. 226.

THE ELECTRIC AND GAS PLANT AT PLATTSBURGH, N. Y.

ONE of the most interesting electric light stations in New York State is that of the Plattsburgh Light, Heat and Power Co. A solution has been reached, or at least attempted, of the problem of combining services that would appear to be injurious to each other, and of operating them in harmony and prosperity. The company owns both the gas and electric light plants, and so far from aiming to promote the popularity of one at the expense of the other, is seeking to get the best results out of the two illuminants, and, while giving satisfaction, to earn the largest possible dividend. The following brief illustrated sketch of the company and its work will be found instructive.

The electric light plant is situated on the banks of the Saranac River, from which power is taken, about half a mile from the centre of the village. The building is of stone and brick 40 feet wide by 160 feet long. A view of it is given in Fig. 1, which also shows the dam headgates and flume. The flume runs clear across the end of the building, inside, and in it are placed three Hercules wheels of 99 h. p. each, with ten-foot head. Each wheel is operated separately, and is provided with a governor. The wheels are vertical, and are geared to a jack shaft above the flume, and below the floor of the dynamo-room. They are belted from jack shaft to countershaft on the floor of the dynamo-room, which is shown in Fig. 2. The countershaft is divided into three sections, and each section is provided with friction clutches. The belts from the pulleys on the jack shaft of the water-wheel to the pulleys on the countershaft are provided with belt releasers, so that steam power can be used alone if desired. The Hill friction clutch and steel rim pulleys are used.

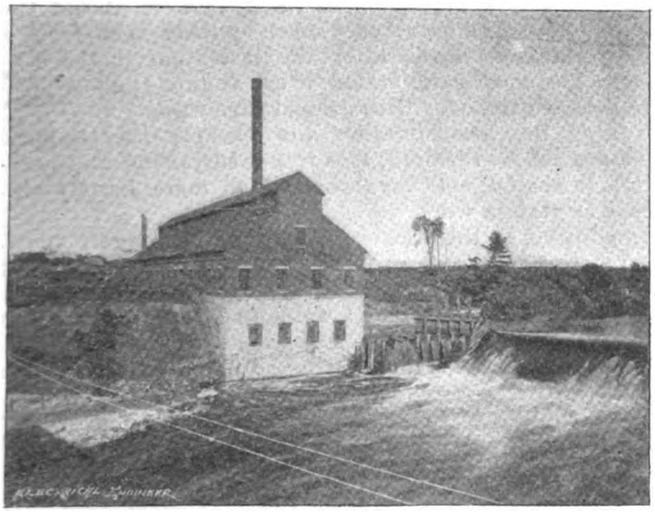


FIG. 1.—WATER POWER OF THE PLATTSBURGH LIGHT, HEAT AND POWER CO.

The steam generating plant comprises two boilers of 130 h. p. each with pumps and injector. The electrical plant proper consists of three Westinghouse alternators of 750 lights capacity each, and two exciters; and two Excelsior arc machines of 45 lights capacity each, all of which are shown in Fig. 3. There are three incandescent circuits, all of which run to one centre of distribution, the extreme end of one circuit being one and a half mile from the station. The power plant was well designed and installed by the Lang & Goodhue Manufacturing Company of Burlington, Vt.

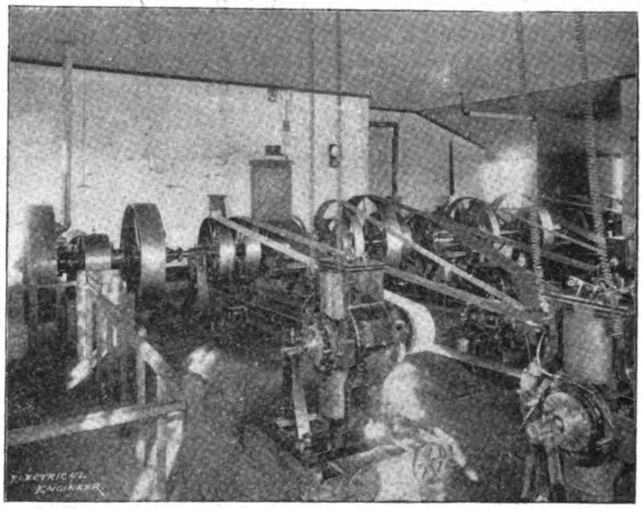


FIG. 2.—DYNAMO-ROOM SHAFTING, PLATTSBURGH STATION, N. Y.

The policy of the Plattsburgh Company is to supply gas and electric light at the lowest possible price, and at a rate so that one will not compete with the other. This end has been arrived at as follows: The price of gas was placed at $2.10 per 1,000 cubic feet, with a discount of ten cents per 1,000 feet for prompt payment, making the net rate $2 per 1,000 cubic feet. The gas being of not less than 20 c. p. to a five-foot burner, this brings the price down to one cent per hour for 20 c. p. gas lights. The company now sought to place the incandescent electric light on the same basis as gas, holding the opinion that the majority of consumers care little of the advantages of one light over the other, except in case of price, and that they will always want the light that gives the most illumination at the least possible expense, regardless of other considerations. To meet the cost of a gas burner consuming five cubic feet per hour and giving equal to 20 c. p. at a cost of one cent per hour, the company placed the price of incandescent light at one cent per lamp hour for a 16 c. p. lamp with a discount of 25 per cent. for prompt payment, which makes a net rate of ¾ of a cent per hour for 16 c. p. incandescent electric light as against 20 c. p. gas at one cent per hour, or practically equal for the same illumination. The plan appears to have worked admirably, as there is a remarkably general use of the incandescent light in residences, and yet its introduction rests wholly with the consumer, primarily on the ground of equal cost, and secondarily because of ulterior advantages.

The total number of incandescent lights now wired is equal to 3,000 16 c. p. lamps and is daily increasing. Over fifty dwelling houses have been wired. All inside wiring is done at the expense of the consumer.

The amount of current used is determined by the use of meters. The Westinghouse-Shallenberger meter is used, and meter rent is charged.

The gas plant comprises two complete sets of apparatus for the manufacture of water gas with scrubbers and purifiers and holder capacity of 10,000 cubic feet, which is inadaquate, and it is proposed to erect a large holder at the location of the electric plant, and to remove the apparatus to the same place. The annual output of gas is 4,000,000 cubic feet. Gas for cooking purposes is sold at $1.50 per 1,000 cubic feet, while gas stoves are supplied to consumers at actual cost, and a number are now in use, giving satisfaction.

The Plattsburgh Light, Heat and Power Company was organized in December, 1889, for the purpose of supplying gas, electric light, heat and power to the citizens of the village and town of Plattsburgh. The incorporators were Messrs. A. L. Inman, general manager of the Chateaugay Ore and Iron Company; John H. Myers, president of the Iron National Bank; S. A. Kellogg, judge of the Circuit Court, all of Plattsburgh; H. M. Pierson, gas engineer of New York City, and George M. Cole of Plattsburgh. The officers of the company are A. L. Inman, president; J. H. Myers, treasurer, and George M. Cole, secretary and manager. The above named and Messrs. Kellogg and Pierson comprise the board of directors. On January 1st, 1890, the company acquired the plant of the "Plattsburgh Electric Company" and the plant of the "Plattsburgh Gas Works," consolidating the interests in the manner already described.

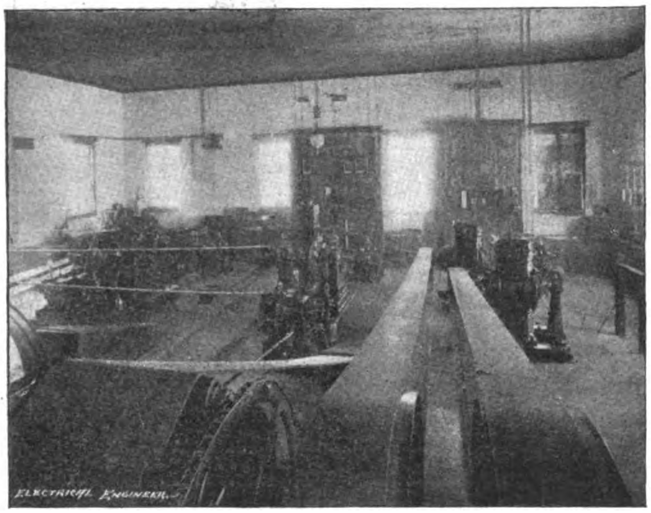


FIG. 3. DYNAMO ROOM, PLATTSBURGH STATION, N. Y.

WATER-POWER IN SWITZERLAND.

A PLANT has recently been erected to utilize the falls of the Valoirette, a tributary of the river Arc, near Mont Cenis. Near the confluence of the two streams a canal, 2,625 feet long, 6½ feet wide and 3¾ feet deep, has been constructed to the reservoir. The canal has a fall of 0.22 per cent., and passes 106 cubic feet of water per second. The entire hydraulic plant is capable of supplying 6,000 h. p., but at present only one establishment—an aluminum factory—has been connected with the reservoir. Connection is made by a 24-inch pipe line sufficient to generate 1,000 h. p. One turbine is connected to a dynamo running at 135 revolutions, and giving an output of 4,000 amperes at 500 volts.

SOME ADVANTAGES OF GRAMME ARMATURES FOR STATION GENERATORS.

BY

Lucius [illegible]

IT is noticeable, though drum armatures have been considered electrically more efficient, that the Gramme type is obtaining much favor because of the accessibility and cheapness as well as the reduction in speed and sometimes of weight which its use permits.

While time is showing how great an enemy to the life of a dynamo is the destructive factor, heat, it may be allowable to emphasize what seems to be one of the most important advantages of the Gramme ring type of armatures, viz., the ability to dissipate internal heat quickly.

Few of the older stations have dynamo-rooms with anything like proper ventilation. In warm climates, stations not systematically ventilated are sometimes unbearable. In several such, where drum armatures were in use, repeated cases have come under my observation of armatures burning out while starting up in the morning, before even the normal E. M. F. had been reached.

These instances almost invariably followed after a particularly hard day's work, when the armature had been stopped on the previous night in a sizzling condition.

A close inspection showed that the cause had been, in all probability, the carbonizing of the insulation on the conductors.

These instances recurring always at starting seemed to show conclusively that the baking received by the armature in its own heat on the previous night had been the last straw needed to break down the insulation.

Usually the paper insulations in the core were loosened and charred, while the wooden or other coverings at the ends were mere pieces of charcoal, the result of slow combustion. Clearly enough, here in these ill ventilated stations the Gramme type would have had unquestionable advantages that should have prevented such untimely deaths by slow combustion.

With the amount of surface exposed and the draft of air kept up constantly by the "spider" of a Gramme ring it is difficult for the heat in the core to become sufficient to carbonize the insulation, and when the dynamo is at rest the internal heat disappears very much quicker than from a drum armature. Even after the insulation in the conductors has much deteriorated, it can endure the low pressure between the coils with comparative ease.

Taking into consideration how cheaply the Gramme armature can be repaired, it is rather surprising that heretofore it should not have been much more largely employed in station work.

In addition to this, the economy of a thoroughly ventilated station free from grit, dust and bituminous coal-soot seems no less evident.

It would doubtless be of value to learn from various comparisons of the two forms of armatures under like conditions, what is the actual average difference in length of life.

AN ELEVATED RAILROAD FOR BOSTON.

THE *Journal* says that a syndicate of New York and Philadelphia capitalists has been trying to secure the passage of a bill which will give them the right to build an elevated railroad in Boston and its suburbs. It is said that the men behind the movement are the same who recently purchased the Belt Line, Lynn and Boston, and Naumkeag and Essex roads. Capt. Griffin of the General Electric Company is mentioned as being in the syndicate.

THEORETICAL ELEMENTS OF ELECTRO-DYNAMIC MACHINERY—XI.[1]

BY

A. E. Kennelly

STRESS DISTRIBUTIONS—(*Continued.*)

As a case next in order of complexity, we may consider a wire bent into the form of a square with length of side l, but so situated that the normal to its plane makes an angle θ with the direction of a uniform field of intensity B. This differs from the case last considered only in the departure of θ from 90°.

Let B be withdrawn, and a current of uniform strength C pass steadily through the wire. The compression on the wire's substance, and the stress acting on the sides of the square, tending to force them outward—systems 1 and 2, according to the results of the preceding chapter—are evidently unaffected by the direction of the plane assumed by the square in space, these forces being only dependent on the distribution of current.

Now introduce the external flux B, whose direction, indicated by the arrow O B, makes an angle θ with the plane normal O N, Fig. 27, drawn positively, or upwards from the plane, on that side which presents the current as flowing counter-clockwise, and its magnetic potentials therefore positive. We may first assume that θ is less than 90°. By rules already discussed, the resultant force on the sides A C and D E will be the vector products of the currents through those sides into B, or numerically $C B l \cos\theta$ dynes in the plane of the square, as represented by the arrows at c and d. Upon the sides A D and C E, B acts perpendicularly, so that the stress it produces on each is numerically $B C l$ dynes in the directions perpendicular to both wire and B, as shown by the arrows a_3 and e_3. These forces make an angle θ with the plane of the square, but resolving into components in and normal to this plane, there remain forces $B C l \cos\theta$ dynes acting along a_1 and e_1 outwards, and $B l \sin\theta$ dynes along a_2 and e_2, tending to rotate the square about an axis in its plane, which, by symmetry, must connect the middle points c d, of A C and D E.

These results may also be reached from a slightly altered point of view. B may be resolved into two components,

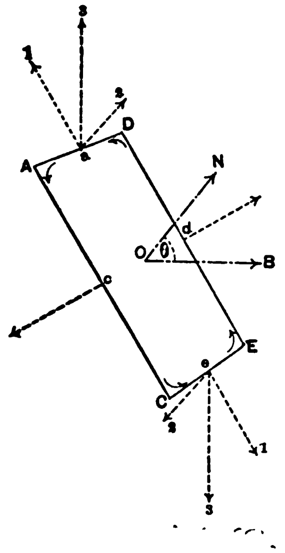


Fig. 27.

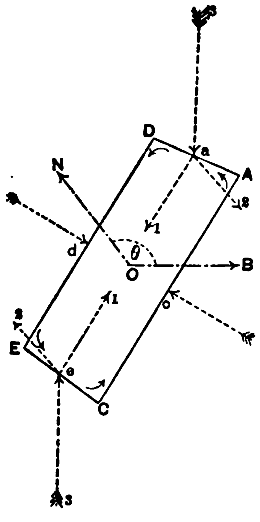
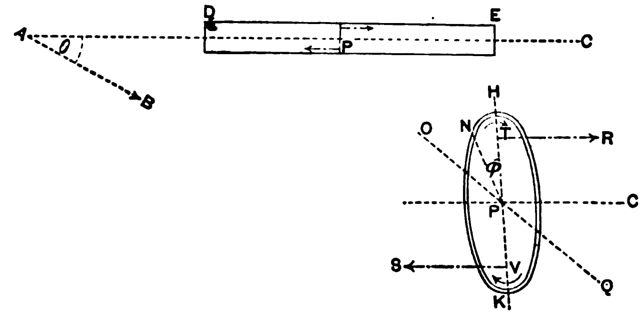


Fig. 28.

one $B \cos\theta$ normal to the plane, the other $B \sin\theta$ lying in the plane. The resultant stresses produced by $B \cos\theta$ on each side of the square are all directed outwards with side resultants $B C l \cos\theta$. The stresses produced by $B \sin\theta$ are $B C l \cos\theta$ upon the sides A D and C E in the directions c_2, e_2, and the remaining sides A C and D E, parallel with this component, are unaffected by it.



Figs. 29 and 30.

If then the resultant system of flux distribution from C and B were completely mapped out, and the consequent stress distribution in virtue of $\frac{B^2}{8\pi}$ duly determined, there would be equilibrium at all points everywhere outside the wire, while the effect on and in the wire may be represented by four systems of forces. The first two, pertaining only to C are the above-mentioned compression and outward push in the plane. The third will be $B C l \cos\theta$ on each side, also directed outwards, and the fourth will be a couple of moment $B C l \sin\theta$, tending to rotate the whole square about its central line c d.

The direction of rotation would be such as to bring the square perpendicular to B, or in other words diminish the angle θ; and if the square were actually constructed as a rigid frame pivoted on an axis through c d, it would be necessary, excluding the consequences of pivot friction, to apply a couple of $B C l^2 \sin\theta$ dyne-centimetres to the frame to maintain its equilibrium under these conditions.

Fig. 28 represents the similar stress system when the angle θ exceeds 90°, so that the flux from the local circuit is opposed to B within the square. In the equivalent quadruple stress system for this case, the first two components regarded from the normal O N are unchanged, but the last two are reversed. $C B l \cos\theta$ now acts on each side inwards, and $C B l \sin\theta$ acts on A D and C E in the directions of the arrows a_2 and e_2, forming a couple $C B l^2 \sin\theta$. This couple tends to rotate the plane first into parallelism with B, and then to continue the rotation through the angle θ until the normal O N coincides in direction with B.

We may apply these principles to the case of a rigid, active solenoid of N turns, pivoted in a uniform exterior flux. This is represented in Fig. 29, where D E is the section through the axis of the solenoid, which is pivoted about its centre of figure P, so as to be capable of revolving as a rigid body in the plane of the paper, about a pivot line through P. The current of C units supplied to the helix in such a manner as not to influence its rotatory freedom, circulates clockwise as viewed from A, so that A B C is the positive direction of the solenoid's axis. A uniform prime flux of intensity B, directed in the plane of the paper, as shown by the arrow A B, makes an angle θ with A B C.

If we withdraw B for a moment, it is evident that the flux in the circuit of the solenoid will bring a system of stress to bear upon its walls. As a rigid body, the helix can undergo no distortion from these, and by symmetry, they cannot tend to rotate it. We may therefore banish them from present consideration. Now restoring the exterior intensity B, we may resolve this into components $B \cos\theta$ along the solenoid, and $B \sin\theta$ perpendicularly across it. $B \cos\theta$ will only produce a radial outward stress on each turn of wire in its own plane, an influence that the rigidity of the walls will keep in check. $B \sin \theta$ will set up a couple in each turn.

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To examine this effect more closely, a single turn of the solenoid is represented, in Fig. 30, to a larger scale; P C is the axis, O Q a line through the axis perpendicular to the component $B \sin \theta$. which acts in the direction H P K. Upon all elements of the turn situated on the same side of O Q as H, the vector force set up by $B \sin \theta$ on C, will be parallel to the axis and in the direction of the arrow T B; while with those on the other side the force will follow the opposite direction, that of the arrow V S. At the points H and K, a small element of the wire, $d\,s$, meeting $B \sin \theta$ at right angles, will be urged with a force $C\,B \sin \theta\, d\,s$ dynes; on elements at O and Q, the force will be nil, and at any intermediate element, such as N, whose position angle N P H is φ, the force will be C B $\sin \theta\, d\,s \cos \varphi$. If all these elementary forces be summed round the circle (whose radius is r), the total force will be $2\,C B \sin \theta\, r$ dynes in each semicircle. This total force applied at the points T and V, whose distances from P are each $\frac{\pi r}{4}$ will be the resultants of the elementary system.

Since each turn of wire will contribute an equal pair of resultants, the total forces referred to the mid-plane of the solenoid will be $2\,N\,C\,B \sin \theta\, r$, at distances $\frac{\pi r}{4}$ on each side of P. The moment M of this couple will therefore be

$$2.2 N\,C\,B\, \sin\theta\, r . \frac{\pi r}{4} = N\,C\,B \sin \theta\; \pi r^2 = A\,N\,C\,B \sin \theta,$$

where A is the area of cross section, and if a pulley of radius R were attached to the pivot axis at P, it would be necessary to apply a force of $\frac{M}{R}$ dynes, or $\frac{A\,N\,C\,B \sin \theta}{981\;R}$ grammes weight at the periphery of the pulley, in order to maintain the coil's equilibrium, assuming the absence of pivot friction.

To take numerical values that might be readily attainable experimentally, if $N = 500$ turns, $B = 1{,}000$ C. G. S, $A = 2$ sq. cms., $C = 2$ amperes or 0.2 C. G. S., $\theta = 30°$, so that $\sin \theta = 0.5$, we have for M, $2 \times 500 \times 0.2 \times 1{,}000 \times 0.5 = 100{,}000$ centimetre-dynes.

A solenoid in a uniform prime flux, experiences therefore, no tendency to translatory motion, but only to rotation; (a tendency to translation would in general be set up if B were not uniform). This rotatory tendency, or moment M, for a given solenoid, exciting current, and prime flux B increases with the deviating angle θ, varying at its sine, from unity when B lies across the solenoid, to zero when B is in line therewith.

Further, the formula for M takes no cognizance of the shape of the solenoid, which is represented simply by the area turns $N\,A$. It might be short or long, thick or thin, the moment would be the same so long as $N\,A$ remained unaltered. The rotatory power of a solenoid carrying a given current in a uniform prime flux, therefore depends only on its total area turns, and a single-turn of 50 sq. cms. will exert the same force as 20 of 2.5 sq. cms. each. These turns need not be all equal of size, provided that they are all concentric; ten in the inner layer might have 2 sq. cms., the outer layer of ten having 3 sq. cms., the sum of the area turns would remain 50. Strictly speaking, this assumes that the wire is filamentary; but if the diameter of the wire is sufficiently great to introduce sensible error, further approximation may be attained by supposing the wire to be subdivided into filaments sharing the current, and summing the area turns again on this basis. The proposition may be true even if the turns be not circular, for it is evident that they may successfully vary in size and shape, if each is symmetrical about a line in its own plane perpendicular to the component $B \sin.\ \theta$ and that all the successive median lines lie in one plane, which will be a plane of symmetry for the coil. Whenever such symmetry is preserved, as is usually the case in practice, the moment of rotatory force is $C\ B \sin \theta$ multiplied by the area turns for the coil.

These are characteristic of the behavior of magnets temporary or permanent in a uniform prime flux. They tend to set their own local and internal flux parallel with that in the exterior field, and the tendency to this alignment, the moment of restitution, is proportional to the sine of the deviating angle. A uniformly magnetized rod is in fact equivalent to a solenoid of the same dimensions carrying a number of current turns that will produce the same magnetic potential difference between its terminal planes, as actually exists between the rod's extremities. In practice, magnets are seldom shaped like solenoids, and are never quite uniform in magnetization, but whatever their shape, and however irregular the space disposition of their M. M. F., there will always be some combination of superposed solenoids of various lengths, shapes, and excitations that would form their magnetic equivalents, so that all problems connected with magnets are reducible, ideally at least, to cases involving only the corresponding virtual solenoids.

All these stress distributions are subject to a general law, whose recognition tends to connect and coördinate their various consequences. In any loop, or coil of wire carrying a current, there is as we have seen, a flux $F = \frac{M}{R}$. If flexible or extensible, the loop will tend by its motion to augment F, by reducing R. It will not only compress the wire so as to shorten the paths immediately encircling it, but the loop will spread into a circle, the form of minimum reluctance for a given length of conductor, and radially extend that circle until held in check by mechanical forces. Similarly, when the loop is subjected to the flux from an external magnetic circuit, it will tend to enclose a greater total flux, and to move to a position wherein F may become a maximum. Magnetic equilibrum whenever attainable in other positions will be unstable.

INSULATED ELECTRIC CONDUCTORS[1]—VIII.

BY

James Bowstead Williams

Shellac.—Found upon twigs and extreme branches of trees growing in Arabia and other parts of the Orient are crusts of resinous matter which, when gathered, are known as *stick lac.* When this stick lac has been boiled in an alkaline solution and the coloring matter removed it is then called *seed lac;* and when this second product has been melted, strained, and poured upon smooth hard surfaces to cool, the resulting thin scales form the *shellac* of commerce. When pure, shellac is one of the most important insulating materials known on account of its high specific resistance, its durability and value as an ingredient of rubber compounds and insulating paints; but, as sold, it is almost always adulterated with rosin. If the rosin used for adulteration be pure, the specific resistance of the shellac is not materially lowered, but its durability is affected in proportion to the amount of rosin used.

Ordinary shellac is not a pure resin but contains wax, gluten, etc., in varying proportions. To obtain the highest insulation of the shellac, the resin must be separated from these other bodies. This can be done in various ways. One process of extracting the resin consists in first dissolving the seed lac in alcohol and letting the impurities settle; then filtering the solution and allowing the filtered liquid to drop into distilled water; and lastly collecting the resin and drying it in a current of warm dry air. If the resin is to be applied in solution, *e. g.*, to saturate paper used in the manufacture of condensers, or to varnish the surfaces of hard-rubber or glass pillars, it is dissolved in absolute alcohol.

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[1] *Copyrighted* 1892, *by J. B. Williams.*

The resin can also be extracted from seed lac by dissolving the latter in pyroacetic ether, which dissolves out the resin only. To apply as a varnish this solution should be diluted with absolute alcohol, as the ether evaporates too rapidly when used alone.

Shellac and, in fact, all resins should be carefully strained or filtered before being used for insulation, in order to remove bits of wood and other foreign matters which exist in all commercial resins. Colophony becomes quite fluid when sufficiently heated, and can then be passed through a filter press or other filtering apparatus; but shellac cannot with safety be made sufficiently liquid by heat, and should therefore be passed through the filtering apparatus while in solution in alcohol or other suitable solvent.

The following items of importance regarding shellac and its uses have been obtained from experiments made by the writer, and are here given as they may be of interest or use to the profession:

1. Shellac does not unite, by melting, with the asphaltes or petroleum, and should not be used in compounds containing such substances if the compounds are to be mixed and applied while in a melted state. This statement does not apply to rubber compounds containing asphaltum, which are mixed and applied while in a plastic state.

2. If it is to be added to any kind of compound containing rosin, the best results will be obtained if the rosin and shellac are combined by heat, the rosin being melted first, and the combination of the resins then added to the other ingredients. When thus used it will, if in sufficient quantity, often remove the stickiness of compounds containing a large proportion of rosin.

3. When finely powdered it can be used as an ingredient of almost all rubber compounds, as it does not attack the rubber when heated.

4. If dissolved in alcohol or linseed oil it combines with other substances which have been dissolved in the same solvents; otherwise, it is generally precipitated.

5. It requires about five hours to fully dissolve in boiling linseed oil.

6. It will combine with paraffine by prolonged heating and stirring if the paraffine does not exceed one-fourth of the weight of the shellac. Such combinations are very durable, and form excellent ingredients for rubber compounds.

7. It combines with most of the resins, if they are in a melted state before it is added.

8. It should never be used alone, or in composition of which it forms the principal ingredient, on any bodies which are alternately heated and cooled, as it is certain to crack and loosen from them.

9. When melting shellac, always use as low a temperature as possible. Most resins can be melted several times and at comparatively high temperatures without injury, but this is not the case with shellac.

10. Shellac readily dissolves by boiling for a few minutes in an aqueous solution of borax or other alkali. But such solutions, while forming excellent cements for various purposes, are of no practical value for insulating purposes unless, after their application and drying by artificial means, they can be *kept* dry. No substances which are applied by means of alkaline solutions and no substances which are soluble in water make efficient insulating material, when used alone, for they invariably absorb moisture when exposed to the atmosphere, even though they may have been baked after their application to fibrous material.

ELECTROSTATIC DISCHARGES.

BY

Philip Atkinson.

Forty years ago, when the fluid theory of electricity was popular, and the one-fluid and two-fluid theories were earnestly discussed, the burr projecting in opposite directions on opposite sides of a card or book perforated by an electrostatic discharge was relied on as a strong point in favor of the two-fluid theory. In Dr. Morton's article on the "Nature of Electric Currents" in The Electrical Engineer of July 20, the same experiment is adduced again in proof of the dual nature of the electric current and the simultaneous movement of electricity in opposite directions, and certain peculiarities in the perforations noted, which he has observed, which seem to sustain this theory and also to indicate a spiral movement of the current.

Having performed this experiment many times and carefully noted the results, I have been led to reject the theory which attributes the double burr to two electricities moving in opposite directions, and to adopt the simpler and more rational one of electric induction and difference of electric potential.

The most striking results are obtained by discharging a Leyden jar or battery through a book or tablet of 50 or more sheets, though the characteristic double burr will be observed when the discharge takes place through a single sheet held between the poles of a Töpler-Holtz machine. The phenomenon is easily explained on the following simple principles. Assuming that electricity is a manifestation of that universal energy which exists in matter, we find that when a difference of potential is produced between the coatings of a Leyden jar or battery by a charge from a static machine, the energy accumulated on one coating is exactly equal to that taken from the other, producing the relative electric conditions known as positive and negative. If now the two coatings be connected by a discharger, one knob of which is in contact with the outer coating, and a book, placed in contact with the other knob, is brought quickly into contact with the knob of the jar, the discharge and perforation will take place; the electric energy employing the paper and discharger as its medium of transfer from positive to negative to restore the equilibrium. As paper is a very imperfect conductor, the discharge is confined to a limited space surrounding a straight line between the knobs; and the electric potential of the paper being zero, is higher than that of the negatively charged coating and lower than that of the positively charged coating; and by virtue of this difference of potential the leaves, on opposite sides, are attracted outward in opposite directions and torn, producing the double burr; being oppositely electrified by induction from each surface inward.

It is important to distinguish between the movement of electric energy and of electrified matter. Electric energy always moves from higher to lower potential, but electrified matter moves, or tends to move, either from higher to lower potential or from lower to higher, with equal facility; oppositely electrified masses being mutually attracted by their difference of potential. Hence while the electric charge, in the above experiment moves from the positive to the negative coating, the paper tends to move in opposite directions.

Dr. Morton quotes explanations from Mascart and Sprague, which are substantially the same as the above. In my "Elements of Static Electricity," published in 1886, pages 81 to 84, the same explanation is given, and I was not aware of a similar one having been given by any one else.

With reference to the indentation on one side of the perforation and outward burr on the other, which Dr. Morton regards as proof of a dual discharge in opposite directions, I find that where this occurs, the line of perforation is diagonal, and not at right angles to the surface of the paper, and that the burr is always on the side next a perpendicular to the surface, and the indentation on the opposite side; as if a pointed instrument had been thrust into the paper and lifted toward the perpendicular. This result is to be expected from the inductive, attractive force acting in the manner described, which is much stronger on the side next the perpendicular than on the opposite side, its strength being proportionate to the angle between the line of perforation and the perpendicular. Suppose this angle to be 85°, it is evident that, the line of perforation being nearly parallel to the surface, the inductive, attractive force would be almost wholly on the side next the perpendicular. Suppose, on the other hand, that the two lines should coincide, the line of perforation being then at right angles to the surface, the attractive force would be equal on all sides of it, resulting in an outward burr all around.

The indentation is evidently due to the repulsive force of the static charge on the paper, which pushes it inward on the side of the perforation farthest from the perpendicular and outward on the side nearest the perpendicular, adding its force to the outward attractive force. As the paper on the farther side of the perforation is forced against the leaves beyond it, the indentation is comparatively slight, while on the nearer side, the outer leaves being lifted by attraction, there is space for the prominent burr produced by the two forces of attraction and repulsion, as described.

These perforations do not occur in single lines on each sheet, as shown in Dr. Morton's diagram No. 1, but are star-like, several lines radiating from a common centre; and I fail to find any evidence of a spiral perforation, such as he describes; in fact his diagram and description show that the perforation occurs in a very irregular manner, being influenced probably by the looseness or compactness of the leaves, and the different relative positions assumed by them under the influence of the electric force. The electric perforation itself is confined to a very limited space, a mere point on each leaf; and the surrounding, star-like perforation, being the result of the force applied to this central point, cannot properly be adduced as evidence of spiral electric action.

Very interesting and instructive results may be obtained by producing a discharge through a book between whose leaves thin sheets of metal have been placed. When the discharge is made between the poles of a Töpler-Holtz machine through a few leaves inclosing two sheets of tinfoil with paper between them, the tinfoil and the paper outside of it will be perforated, the burr on the paper turning outward and that on the tinfoil inward, while the paper between the tinfoil sheets will not be perforated. When the discharge is made between the poles of a large Leyden battery through 30 or more leaves, between which two sheets of tinfoil have been similarly placed, the perforation will extend through a few of the inside leaves between the tinfoil sheets, the burr on these, on the tinfoil, and on one or two of the outer leaves next it turning inward, while that on the other outer leaves will turn outward. If the metal sheets are rigid, like thin spring brass, they will not be perforated, but indented inwardly, if thin enough, nor will any of the leaves between them be perforated.

These results show that while most of the outer leaves are perforated by outward attraction, as shown by the outward burr, the tinfoil sheets and leaves adjacent to them, both inside and outside, are perforated by inward attraction and the brass sheets indented. This inward attraction is accounted for when we consider that the interior insulating paper, with conducting metal on its opposite surfaces, produces exactly the conditions found in a Leyden jar, two charged conductors insulated by a dielectric. The outer leaves become inductively electrified, positively and negatively in the usual manner, the charge being concentrated on a central line, but when it reaches the metal sheets, it is instantly distributed through their entire mass, acting inductively through the intervening paper, and attracting the opposite metal sheets and adjacent leaves. But the paper, being an imperfect insulator, the charge thus distributed passes quickly through it from positive to negative without disruption, unless it is too large to be entirely absorbed by the metal, in which case the surplus will perforate a few of the interior leaves, and indent others till its force is expended; the tinfoil being always perforated, and the brass indented, at the central points of concentration; the metal and the interior leaves of paper which are perforated yielding to the inward attractive force.

I have frequently examined Leyden jars perforated by an overcharge, and find that the perforation is confined to a central spot, about $\frac{1}{32}$ of an inch in diameter, in which the glass is pulverized without being removed, and around which is a star-like fracture. In this case the electric energy traverses the glass from positive to negative, at a thin spot where the resistance is least, on which it becomes concentrated during the discharge; and the glass, being hard and a good insulator, is pulverized by the molecular electric action; but the particles, being attracted toward each other from the opposite surfaces, are not removed.

TWO SIMPLE METHODS FOR TESTING STREET CAR MOTORS.

BY

Cary T. Hutchinson

HAVING occasion recently to make tests on certain tram motors, and not finding any other methods altogether satisfactory, I finally adopted the methods described here. They seem to be simple in the manipulation and readings required, and as there is a certain amount of newness about them, it seems worth while to give a brief description of them.

The description here applies directly to series motors; the changes for shunt motors are obvious. Two motors are required which must be identical; in measuring the efficiency at the armature, the armatures of the two are placed in line and a coupling put on, either solid or flexible. Belts could be used with pulleys on the armature shafts, but this would not insure exactly the same speed for the two, and this is necessary. In measuring the efficiency with the gears, that is, on what would correspond to the car axle, the axle gears of the two motors are connected to a common shaft, just as if two motors were mounted on the same car axle. One of the machines runs as a motor and drives the second as a dynamo; in the first method the dynamo returns its current to the motor, as in Hopkinson's method; in the second method, the dynamo works on resistances.

First method: Fig. 1, A and B are the two motors under test; G is a 500-volt dynamo, which must be of sufficient size to supply the difference between the current in A and B; D is a dynamo, which must generate an electromotive force equal to the loss of potential in the resistances of the machines A, B, D, and must carry the current of B, G, then, supplies the loss of current between the two machines, and D the loss of potential. The fields of B and D are both separately excited.

The rationale of the method is this: The adjustments are made until the value of the field current in the separately excited fields of B is the same as the current in the motor A; the two motors are then running at the same speed in fields of the same strength; hence the hysteresis, eddy-current and friction losses of the two are equal. Knowing then the input of A and the output of B and allowing for the field heating in B, the total loss in the couple is determined; half this loss is in each machine, and so the efficiency is known. It should be noted that it would be incorrect to take the efficiency of one machine as the square root of the couple efficiency; this has always seemed to me to be an erroneous assumption in Hopkinson's original method; the reason of course being that the two machines are not working at the same load, the input of one being the output of the other. The error probably is a small one in most cases, but I think it is much better to arrange that the losses in the two should be identical.

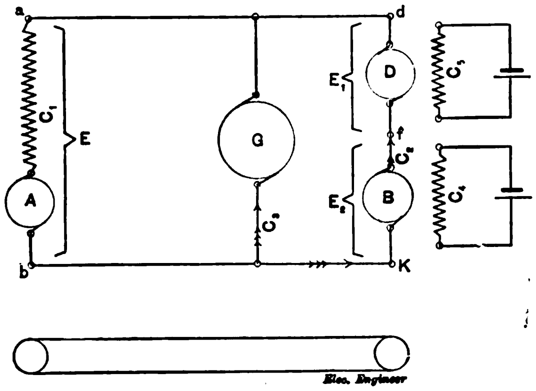


FIG. 1.

Let E be the potential difference at the terminals of the motor A, always kept 500 volts.
E_1 be the P. D. at the terminals of D.
E_2 be the P. D. at the terminals of B.
E_3 be the P. D. at the fields of A.
C_1 be the current in A.
C_2 be the current in the armature of B.
C_3 be the current in G.
C_4 be the current in the fields of B.
C_5 be the current in the fields of D.
R be the resistance of the fields of A or B.
r be the resistance of the armature of A or B.

The manipulation is simple: The current in the fields of B, C_4, is adjusted to whatever load is desired on A, then C_5 is adjusted, by resistances, until the current in A, C_1, is equal to C_4; C_4 is then given another value and the same process repeated. A simplification of this, used later, consists in connecting the fields of B in series with A; the objection to this is the high E. M. F. required from the dynamo G which must be driven considerably over speed.

Call φ the efficiency of the motor; then

Output of motor A $= \varphi\, C_1 E$
Losses in " $= E\, C_1\,(1-\varphi)$
Input of B $= \varphi E\, C_1$
Output of B $= C_2 E_2 = C_2\,(F - E_1)$
Losses in B $= \varphi\, C_1 E - C_2\,(E - E_1)$

Total actual losses in A and B $= E\, C_1 - C_2\,(E - E_1)$ (1).

To this must be added, in order to make the losses in B equal to the losses in A,

For armature of B, $(C_1{}^2 - C_2{}^2)\, r$
For fields of B, $C_1{}^2 R = C_1 E_3$.

This makes for the total losses which would occur in the system if B were running with the same loss as A,

$$2\,H = [E\, C_1 - C_2\,(E - E_1) + r\,(C_1{}^2 - C_2{}^2) + R\, C_1{}^2] \qquad (2).$$

The efficiency of A is

$$\varphi = \frac{E\, C_1 - H}{E\, C_1}$$

$$= \tfrac{1}{2}\left[\, 1 + \frac{C_2}{C_1}\left(1 - \frac{E_1}{E} \right) + \frac{C_2{}^2\, r}{C_1\ E} - C_1\,\frac{R+r}{E} \right] (3).$$

But the machines are identical and therefore the E. M. F.'s of the two are equal.

Or, $E - C_1\,(R + r) = E - E_1 + C_2\, r$

$$E_1 - C_2\, r = C_1\,(R + r) \qquad (4)$$

$$\varphi = \tfrac{1}{2}\left[\, 1 + \frac{C_2}{C_1} - (C_1 + C_2)\frac{R + r}{E} \right] \qquad (5).$$

This formula gives what may be called the measured efficiency, that is, the efficiency for the degree of heating at which the motor happens to be at the moment; measurements made at intervals of half an hour and calculated by this formula will not agree among themselves, particularly when the motors have high resistances as most tram motors have. To take an example; a No. 6 Sprague motor, switch in first position:

$R + r$, (cold) $= 10.5$ ohms.
$R + r$, (hot) $= 12.5$.
$\frac{C_2}{C_1} = .5, \quad C_1 + C_2 = 30.$
Then $\varphi = 43.5$ per cent., for 10.5 ohms.
$= 37.5$ per cent. for 12.5.

Even for the running position, the seventh, the resistance will vary from 1.9 to 2.3 ohms, and

if $\frac{C_2}{C_1} = .7 \qquad C_1 + C_2 = 50,$
$\varphi = 75.5$ per cent. for 1.9 ohms.
$= 73.5$ for 2.3.

These figures are from tests and might easily be exceeded.

This shows how important it is that all such tests should be reduced to standard conditions of heating; this can be done very simply by first determining upon the standard resistances, R_0 and r_0, by preliminary measurements. They should be taken at a mean value of the rise of temperature. The efficiency becomes for standard resistances R_0 and r_0,

$$\varphi_0 = \tfrac{1}{2}\left[\, 1 + \frac{C_2}{C_1} - (C_1 + C_2)\frac{R_0 + r_0}{E} \right] \qquad (6)$$

The substitution of the standard resistance for the actual, as just made, involves the assumption that the resistance is an independent variable; that is, it may vary without causing changes in any other of the quantities entering the expression. This is not strictly true, for when the resistance of the motor increases, its speed diminishes, and therefore C_1 will change; this in turn will change C_2. It will be noticed, however, that the main term is $\frac{C_2}{C_1}$, and although the quantities themselves may change, their ratio remains constant well within the limits of error of work. This I have verified by a number of experiments; the error is trifling. But $(C_1 + C_2)$ enters also; this is, however, merely a correction term, and the slight variation in $(C_1 + C_2)$, less than 2 per cent. will not affect the result appreciably; it might make a difference of .2 per cent. This is within the limits of error.

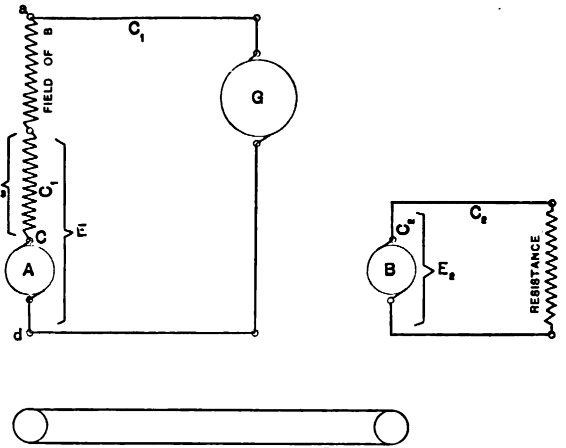


FIG. 2.

Formula (6) is then the expression for the corrected efficiency; this makes the observations very simple, and the possible accuracy very great. There are only two readings to be taken, C_1 and C_2; E is kept constant at 500 for tram motors, and not read; $\frac{R_0 + r_0}{E}$ is a constant; the accuracy of the ammeters is not a matter of great consequence, provided only that they agree between themselves; in fact, one instrument might be used, first in one circuit and then in the other. The only place at which any inaccuracy in the instruments causes error is in the last term, and here an error of 10 per cent. in the instruments would cause only 1 per cent. in the result at maximum load, and at smaller loads, a proportionally decreased error.

The second method is shown in Fig. 2. Here the fields of B are kept in series with the motor A; making exactly the some assumptions as before the efficiency is readily found to be

$$\varphi = \tfrac{1}{2}\left[1 + \frac{C_2}{C_1} - (C_1 + C_2)\,\frac{R + r}{E}\right] \qquad (5)$$

and for standard resistances,

$$\varphi_0 = \tfrac{1}{2}\left[1 + \frac{C_2}{C_1} - (C_1 + C_2)\,\frac{R_0 + r_0}{E}\right] \qquad (6)$$

These are the same formulæ as found in the first case; it may at first glance seem a little strange that with two more machines the efficiency formula should be the same; but the additional machines are used to permit the output of B to be returned to A; the disposal of the output of B should not in any way affect the formula for efficiency.

This last method is simpler as it requires two fewer machines; but in practice the conduct of the tests is as simple in one case as in the other.

Having the efficiency curves, the torque is deducible when the speed curve is known; in taking speed measurements it is again very important that they be reduced to the speed for standard resistance.

To accomplish this in taking speed readings, the P. D. at the motor terminals and at the armature must be measured for every speed reading; the armature resistance should be measured before and after each set of speed readings, and its value for any time determined by interpolation. Knowing the actual armature and field resistance it is easy to reduce the speed to the standard.

The assumption that E. M. F.'s of the machines are equal requal, requires a word; it need not be rigorously true; a considerable variation between the two will affect the efficiency slightly, as the difference enters only in the correction term.

It will be noticed that this latter method affords a very simple means of testing tram motors when on the car; the car can be jacked up, and a pulley put temporarily on each car axle, so that one can drive the other by a belt; then making the connections as in Fig. 2 and using the regulating rheostats as resistances in the circuit of the machine which acts as a dynamo, the efficiency can be easily determined approximately.

A number of tests have been made by these methods, some of which may be published later.

CHANGES IN THE CANADIAN PATENT LAW.

THE Canadian patent law has been further amended and changed so that, when a previous foreign patent exists, the foreign inventor is given the same protection enjoyed by the Canadian inventor, which prevents any one from acquiring the right to manufacture and sell the patented article by reason of his having commenced its manufacture in Canada before application had been made for the Canadian patent.

The first line of the last clause of the article in our issue of August 17th should now read, "Any inventor electing, etc," instead of "A citizen of Canada electing, etc."

MORE REMARKS ON RAILWAY POWER PLANTS.

BY

COMailloux.

THE discussion on "Railway Power Plants" going on in these columns has developed some interesting facts and some valuable engineering knowledge and experience for which we are largely indebted to Mr. Wm. Lee Church, who appears incidentally to have scored a few good points in favor of his views, and of his *engines*. The writer, though greatly interested in Mr. Church's clever presentation of his views, had no intention of taking part in the "symposium" until after reading the *défi* which Mr. Church gives the Yankee, when he says: "I think it beats even our boasted Yankee ingenuity to see a decent way to accomplish this."

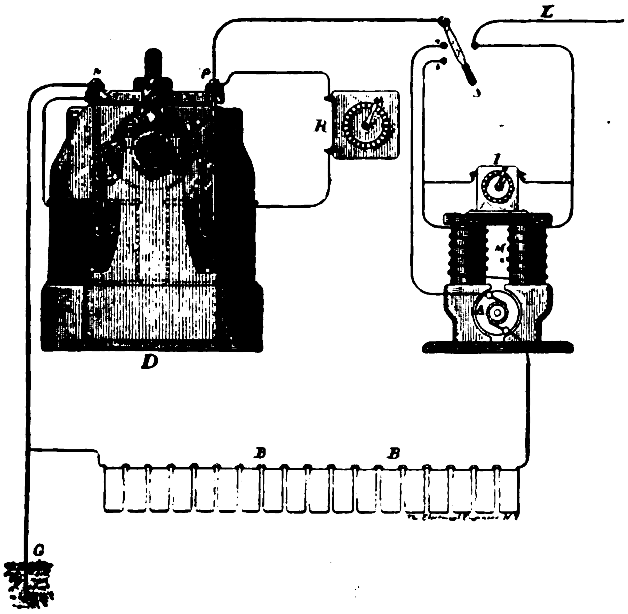
This has emboldened the writer to remind Mr. Church that Yankee ingenuity, when attacking the problem of securing constant fuel economy under variable loads, need not necessarily confine itself to *mechanical devices*, when a "more decent" way can be found in *electrical devices*. The writer expresses candid admiration for the mechanical skill and ingenuity which Mr. Church and his associates have brought to bear on the evolution of the compound engine, and he applauds without stint the *tours de force* exhibited by the performance of their engine. At the same time he feels a certain sense of humiliation in the consciousness of the fact that the American electrical engineer is tacitly acknowledging his inability to "hold up his own end" when he imposes such additional responsibilities on the steam engine. It has, indeed, seemed to the writer as though electrical engineers had already asked enough, if not too much, of the steam engine, in the way of speed regulation; without being too captious on the score of economy. The writer believes that when the electrical engineer rises to the full height of his mission in connection with the design and operation of railway power plants he will himself attend to the load fluctuations *electrically*, without assistance from the steam engine, which he will thus relieve of much serious and unfair responsibility concerning regulation, economy, and, above all, repairs. That is what is meant above by "holding up his own end." There will doubtless be found many ways of accomplishing the purpose. The writer has devised one way, which he described in THE ELECTRICAL ENGINEER of Dec. 3, 1890. It may be of interest to the electrical public to reproduce the diagram used in describing the method. The object in view is thus defined in the article: "The method aims to accomplish electrically for the dynamo what the fly-wheel does in a mechanical way for the engine. It provides the circuit with a kind of reserve fund of energy, that is ready to instantly appropriate any surplus of electric power when the load is light, or make up the deficit when it is heavy."

As for the method itself it consists in attaching to the generator D at the station, a series of small storage batteries, and a small supplemental dynamo, whose armature A (driven by the same engine as D or by a motor supplied from the trolley line), is in the battery circuit, while its field magnet coil M, consisting of a few turns of large wire, is included in the trolley circuit. A switch S can be introduced by which this "compensating circuit" can be thrown on and off at pleasure, as the diagram readily shows. When there is no current on the line, the supplemental armature A revolves in a dead field and there is a large "overflow" of current into the batteries B, B, which charges them. As the current sent over the trolley rises, however, it causes the magnetism in field magnet M to rise correspondingly. This causes the E. M. F. of the armature A to rise and add to the E. M. F. of the accumulators, B B. Hence as the current used on the trolley *increases* the charging current sent into the batteries *decreases*, thus maintaining the *production* (by the engine) nearly or quite constant. If now the current on the trolley rises above a certain normal predetermined value regulated by adjustment, the battery begins to discharge into the trolley circuit *in proportion to the demand, i. e.*, it furnishes the surplus required, and again the production at the engine and dynamo remains constant[1]

By some such system of electrical equalization and compensation we obtain the condition of a practically constant load, not varying probably 10 per cent. either side of the average load, and we thus relieve the engine of the difficulty and responsibility of maintaining close regulation of speed and keeping up good fuel economy.

Mr. Church's plan for the promotion of fuel economy, involving, as it does, in its complete essence, a special make of engine, may be good enough for new plants. But what is to become of the scores of plants equipped with "the other kind" of compound engines?

There is only one remedy:—electrical equalization of the load by some such method as that referred to! These companies and their managers can then hope to bring back the water consumption from 50 pounds to about the amount promised by the agent who sold them the engines; and they *can keep it there.*



Accumulators in a Railway Power Station.

They will also find their engines running much more smoothly than ever thought possible in a railway plant and a material reduction in the cost of repairs will also be observed. This is one point where the electrical method of compensation has the advantage over Mr. Church's; as the latter method can scarcely be expected to decrease repairs. The most pleasant surprise perhaps, will be to find that the plants have now a much greater margin of power than before, for it is not necessary then, to run the engine normally underloaded. In fact the proportions may now be, (taking Mr. Church's illustration) as follows:

Dynamo	60
Engine	60
Boiler	60

Hence, even with Mr. Church's ideal small plant (dynamo 100, engine 100, boiler 60), the operating capacity can be increased 66 per cent. by simply putting in 40 h. p. more of boiler capacity.

The storage battery in the compensating circuit at the station would readily supply as much as 100 h. p. more for the brief "spurts," experienced in railway working so that the plant has ample margin. It is a mere question of size of battery. A fluctuation of 1,000 h. p. can be "compassed" quite as easily as one of 100 h. p.

It is not, as generally supposed, small stations alone that need some form of "load compensation." The paper of Messrs. Shepardson and Burch on the Minneapolis Street Railway station tests (referred to by Mr. Church) shows that some large stations would be benefitted by it. The use of the planimeter and a few calculations enabled the writer to deduce from the curves given in Fig. 11, by the authors, some data which may be of interest in this connection, even though their accuracy may not be absolute.

The following table exhibits these data:

	Main ammeter. Station No. 1.	Main ammeter. Station No. 3.	Feeder No. 1. Station No. 1.
No. of cars supplied..	190	72	30
Calculated mean current value in amperes..........	2,138	1,148	485
Highest point reached by ammeter.	2,680	1,600	725
Percentage of highest current over mean value....	25 %	39 %	60 %
Lowest current value, amperes	1,400	830	300
Percentage of same below value..	35 %	28 %	38%
Average fluctuations of 10 per cent. and more above mean current, (per minute.)	1.4	1.4	4.0
Average fluctuations of 10 per cent. and more below mean current, (per minute)................	1.4	1.6	3.6

These figures would indicate that there is still room for electrical compensation even with circuits supplying a large number of cars.

The sole objection that has been urged against electrical compensation methods such as that referred to, is that they involve using a *storage battery*,—an appliance which is far from being popular with trolley roads, for reasons which their managers would in most cases be at a loss to define. Until lately the average trolley man would not listen with patience to any project having a storage battery connected with it, no matter how palpably evident and certain its advantages or its economy could be made. The writer has indeed "fallen from grace" in the estimation of several of these worthies, because he happens to retain faith in the storage battery. The trolley roads are nevertheless bound to come to the adoption of methods of electrical load compensation or equalization with storage batteries, just as they are bound to come to multipolar slow-speed generators coupled direct to multiple-expansion engines, and other improved methods for reducing the cost of power.

THE TROLLEY SYSTEM FOR NEW YORK.

The aldermen of New York have voted an extensive franchise to the Union Railway Co. for a number of trolley lines in the suburban or annexed northern district of the city. It is provided that the road shall begin to pay the city one per cent. of its gross receipts when the income averages $1,700 per day. This is a decided victory for the trolley.

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[1] For a more elaborate elucidation of the *rationale*, details and advantages of the method, the reader is referred to the original article.

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Nothing is so good as an experiment which, while it sets an error right, gives as a reward for our humility in being reproved, an absolute advancement in knowledge.—Faraday.

STORAGE BATTERIES IN CENTRAL STATIONS.

AN American electrical engineer who was recently in Europe, made it a part of his duty there to inquire into the reason of the large use of storage batteries in the central stations there. In view of the fact that so little use is made of batteries in American stations, the inquiry was very interesting, but it cannot be said that any argument or condition was discovered likely to change the state of affairs here. Our informant tells us that he was struck with the smallness of the plants and the extreme lightness of the load at certain hours. The load diagrams were alpine in the sharpness of their peaks and the sheer depth of their valleys. Of course with a demand tapering off to nothing, say between 3 a. m. and 9 a. m., it would be easy to utilize batteries very nicely, and to treat the batteries during the hours of full operation as though they were a steady customer for a fixed amount of current. But he did not discover any instance in which the batteries came in as a valuable auxiliary to relieve a station at times when the load became abnormally heavy. That was a pretty theory not borne out by the practice.

Another point that impressed our informant was the undue proportion of the batteries to the generating plant in space occupied. The dynamo-room seemed to be very much like the ideal smoking-room that Barrie describes in "My Lady Nicotine"—a vanishing quantity, its fair proportions too often inviting annexation. It also appeared that the batteries themselves were given a wonderful amount of care and attention. If one became "sick," it went into hospital, and its nurse thought nothing of sitting up all night with it. On the contrary, an American when he gets a troublesome battery, heaves it into the scrap heap—and makes an assignment.

This criticism from one who is a trained observer may discourage the idea of the use of batteries in large central stations, but we are still of opinion that the smaller stations have a place for them. As for the care bestowed on apparatus, that is a lesson we still have to learn from the Europeans and the Japanese. Not only in moderate sized lighting stations should room be found for storage batteries, but Mr. Mailloux contends that there is a rôle for them to play in the smaller electric railway plants.

THE TROLLEY FOR NEW YORK.

IT is matter for congratulation that the aldermen have granted, with the Mayor's confirmation, an extensive franchise, with reasonable conditions, to the Union Railway Company, which will operate a number of trolley roads in the northern suburbs of the city, beyond the Harlem. The trolley is pre-eminently the best means of service for that region, and the inhabitants will, without doubt, soon be glad that they enjoy it. A few of them may now oppose it, but they will be like the people in other cities who have no sooner seen the trolley cars go into operation than they have become frantically anxious to get them on every possible and impossible route.

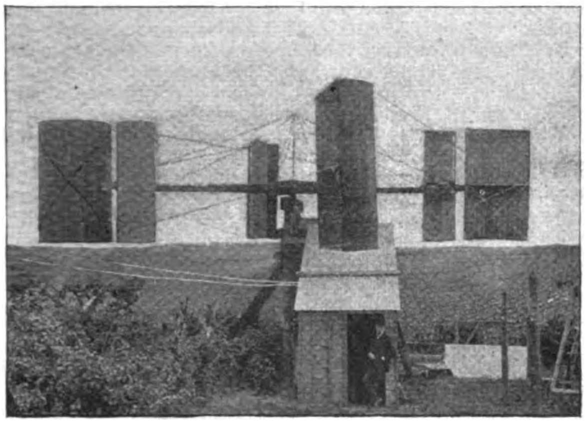
This victory has been achieved in spite of the abuse and misrepresentation of a large part of the press, including not only some of the respectable papers but also the *World*, which has been just as ready and facile in faking "trolley accidents" as it has in manufacturing "special cable dispatches." The trolley is not deadly and is not dangerous. It is a great and lasting boon to those in need of better transportation in our great cities; and we are glad to see that the *New York Sun*, with its wonted strong common sense in dealing with practical affairs has recognized the good qualities of the trolley and has said the kindly, true word on the subject. The trolley car is here to stay and is destined to have at least as long a life as the steam locomotive, no matter what other great advances may be made in electric traction.

THE ELECTRIC UTILIZATION OF THE WIND.

THE arrangement of wind-wheel for generating electricity adopted by Prof. J. Blythe, of Scotland, and described on another page,is of especial interest, completely obviating as it does two of the greatest complications heretofore contended with; namely, automatic means for keeping the wheel to the wind, and also to prevent racing. By the clever adaptation of the principle of the ordinary anemometer, Prof. Blythe has succeeded in charging his accumulators in all kinds of weather, from a gentle breeze to half a hurricane. The device should be of especial value in flat countries and upon the coast where water-power is scarce, coal expensive, and atmosphere plentiful. It will be remembered that Mr. C. F. Brush has made some very interesting experiments, once illustrated in these pages, in the electrical utilization of wind power, and we would suggest that at least one dynamo or storage company would find it advantageous to illustrate practically either the Brush or the Blythe method at the World's Fair.

WIND POWER FOR THE GENERATION OF ELECTRICITY.

An interesting application of the windmill for generating electric power and light through the medium of accumulators has recently been made by Prof. J. Blythe, of Scotland, and is the result of a long series of experiments.



Prof. Blythe's Windmill.

In the summer of 1887 Prof. Blythe erected his first electric windmill in the village of Marykirk, Kincardineshire. At that time he procured a set of 13 accumulators and constructed a windmill of the old English type, having four arms or whips and canvas sails. The length of the arms was about 14 feet, and the sails over 8 feet by 3 feet. The mill was provided with bevel gearing at the top, a vertical shaft and bevel gearing below, so arranged that the driving wheel moved always in the same vertical plane, no matter in what direction the wind shaft pointed. The mill was turned into the wind by hand, having no tail or other gearing for keeping it automatically head to wind. The dynamo was driven by a belt from the driving wheel, and with this he was able on two or three windy days to store his cells. Although the experiment was not on a very large scale, it was sufficient to show that accumulators could quite well be charged, when the electrical connections were properly made, by a dynamo driven at the irregular speed characteristic of a windmill. Sails were not a great success, especially since there was no way of reefing them. To prevent their being torn to pieces, the mill had to be stopped when the wind was high; just at the time when it should have been going at its best.

To remedy this partially the wind-wheel was altered from the English to the American type, having a number of arms and blades of sheet iron. He also introduced the further improvement of doing away with the necessity of having the driving wheel always in the same plane. This is absolutely necessary if the windmill is to drive a sawmill, a cornmill, or anything of that sort, but for electrical purposes the dynamo can quite easily be attached to the wind shaft platform so as to turn with the mill as the wind changes. In this way all gearing is avoided, as the dynamo can be driven by ropes from a large wheel keyed directly on to the wind shaft. This answered very well so long as the wind had a moderate speed, but like all other windmills, it had either to be made self-reefing or stopped altogether when a gale came.

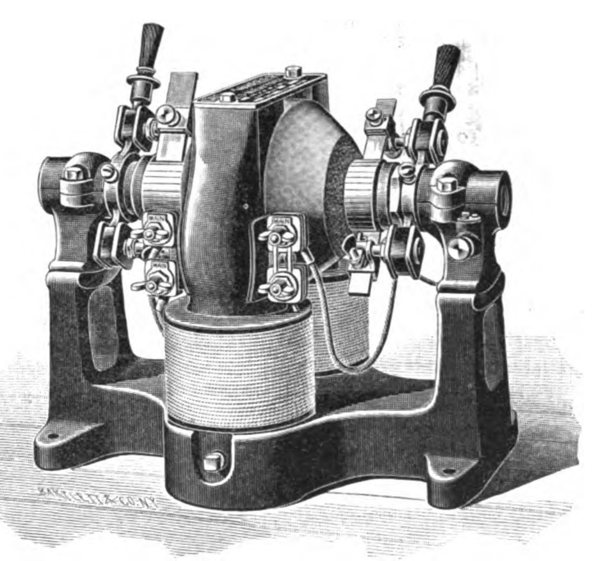
A possible solution of the problem was presented in the Robinson anemometer, which consists of four hemispherical cups attached to four arms, and moving in a horizontal plane about a vertical axis. From the theory of this instrument, which is however only approximate, it appears that whatever might be the speed of the wind, the speed of the cups attained a certain *terminal* value, such that the couple due to the wind pressure was exactly equal to that produced by the resistance to the motion through the air and the friction on the bearings.

Last summer he erected a machine of this kind, a good idea of which is given in the accompanying illustration, which has been considerably improved within the past three months. The cups are replaced by semi-cylindrical boxes attached to four strong arms, each about 26 feet long; the opening of each box is 10 feet by 6 feet, and the vertical shaft is a long rod of iron 5 inches in diameter. At the lower end it carries a massive pit wheel, which actuates a train of gearing, and drives a flywheel 6 feet in diameter with the requisite speed for driving a dynamo connected with it by a belt in the ordinary way. This machine worked most satisfactorily, and with a fair wind speed, gave about two electrical h. p. It was also tested in a strong gale, by allowing it to run with no load, and the result was perfectly satisfactory, as a safe terminal speed was attained and all racing avoided. During the past few months the power of the machine has been increased by adding an auxiliary box to each arm with a gap between it and the previous one. As the whole is a case of vortex motion the theory is very difficult. Information can only be got from models and by applying the principle of dynamical similarity.

All that is necessary is that the circuit be broken when the dynamo is running at less than the storage speed. This is easily managed by a governor attached to the dynamo shaft, and which makes and breaks contact in a mercury pool at the required speeds. A form of governor has also been tried which throws a greater or less number of cells into the charging circuit as the wind varies and in this way the machine is always doing some work.

THE CROCKER-WHEELER MOTOR-DYNAMO.

The Crocker-Wheeler Electric Company, on account of the growing demand for direct current, for special purposes, differing from the three great standards of voltage, have gone into the manufacture of machines to transform direct current from one potential to another. These transformers, or motor-dynamos, resemble motors or dynamos in all respects, except that the electrical parts are in duplicate. One side of the machine is devoted to receiving the current from the standard source, and, after transformation, the other side distributes it at the potential desired.



Crocker-Wheeler Motor-Dynamo.

It is often customary for shops which do silver and gold plating in moderate amounts, to take their current, which must necessarily be of large ampereage, from 110-volt Edison mains, cutting down the voltage by means of large incandescent lamps. They are thus paying for their current at 110 volts when they are only using two or three volts. By the use of a direct current transformer, a consumption of 10 amperes in this manner would be reduced to about ¾ of an ampere, saving thereby from 90 to 95 per cent. of the expense. Another instance which does not recommend itself as much on the ground of economy for actual current consumed as on the ground of compactness and absence of attendance required is the ringing of bells, etc., in large hotels, which now employ from fifty to one hundred primary cells, at a cost per year of about one dollar each. The smallest size dynamo-motor made, weighing about 30 pounds, will do the work of two hundred and fifty of these cells, and at the end of the year would cost for the equivalent output about one quarter as much. The larger sizes take current at from 600 to 6 volts at the motor end, and deliver it at the dynamo end at from 6 to 600 volts, and may be used as well as the smaller sizes for charging storage batteries, generating currents for telegraph circuits, transforming from direct to alternating current for telephone bells, etc.

The Crocker-Wheeler Electric Company, New York, is now making these machines in sizes from type ⅙ to 3 h. p., the smallest size taking current at the motor end at from 230 to 6 volts and delivering current at the dynamo end at from 6 to 230 volts. The shaft of type ⅙ can be so arranged that a dental drill may be attached to it, an emery or polishing wheel put on for polishing and sharpening tools, a fan for raising a breeze, or current taken from the dynamo end for heating cautery wires, and for other medical uses. These machines, one of which is shown in our illustration, are made with the great attention to details for which the Crocker-Wheeler Electric Company is noted, and the demand for them will grow as they become better known.

THE PURCHASE OF SUBMARINE CABLE ABROAD.

In the last issue of The Electrical Engineer, attention was called to the fact that despite the obligation now resting upon the United States Government under the new McKinley tariff law to pay duty on its taxable imports, as a private citizen does, the Weather Bureau proposed to buy its submarine cable abroad, and that Prof. Harrington, having to purchase two light cables for signal stations in Lake Huron had simply doubled his estimate for the purchase of such cables in Europe. We are now in receipt of the subjoined interesting letters on the subject from American cable manufacturers:

DAY'S KERITE.

New York, Aug. 24, 1892.

Replying to your favor of the 23d inst. relative to the importation of submarine cables, I see no reason why our manufacturers cannot make such cables.

My facilities are such that the manufacture of a "Kerite" cable, meeting every requirement is practicable, and at a considerably less cost than an imported cable.

You do not state the specifications for the seven-mile cable for two proposed weather signal stations on Lake Huron, without which it is impossible to give exact figures.

I suppose it is hardly necessary for me to more than suggest the recognized fact that "Kerite" possesses qualities which have stood all submarine tests for a great many years, and that I am constantly making cables for this purpose.

There is no reason why our Government should go abroad for its submarine cables.

W. R. Brixey,
Manager.

BISHOP GUTTA-PERCHA CO.

New York, Aug. 24, 1892.

In answer to your request for a reply from me to the article in The Electrical Engineer August 24th, relative to the manufacture of electrical cables in this country:

It is true that there are no manufacturers in the United States capable of making the long ocean cables, as that requires *ships* to lay, as well as factories to make, and since iron wire is the largest item of cost in the long cables, and that is much cheaper in Europe than in this country, as are also the labor and the ships, the long cables cannot be made here. Of course we could have no protection on them.

On the other hand, the McKinley bill did not affect the tariff on cables,—the duty being before and since its passage 35 per cent. ad valorem.

There are several cable factories in this country, and the Western Union Company and all telephone companies are supplied by them. We are almost constantly making cables for the Government for different departments—Light House, Life-Saving and Signal Service—and two years since made 40 miles for the Sandwich Islands.

Under the Cleveland administration the Government imported its cables "in bond." This gave the home manufacturer no show. The McKinley bill makes the Government pay the same duty as individuals, viz., 35 per cent., and this enables us to make cables in competition with Europe and make a small profit, unless work is very slack in English factories when they make them very cheap. The McKinley bill does not change the cost to citizens and only adds 35 per cent. to cost of Government cables.

We would be very glad of the order to make and lay the Lake Huron cable at $1,500 per mile now.

Whatever may be said in favor of *free trade* generally, I think few people will consider it more onerous for the Government to pay the duty than for individuals.

We have just offered to make for 10½ cents per foot, $554.40 per mile, 12 miles of cable for life-saving stations: and the English in this case beat us at that. I am sure that is as low as the Government ever got one, even without duty—notwithstanding the fact that gutta-percha is worth fully 50 per cent. more than it was four years ago.

Henry A. Reed.

THE INDIA-RUBBER AND GUTTA-PERCHA INSULATING CO.

New York, Aug. 26, 1892.

In re "Importing Submarine Cables"—under the old tariff the Government paid no duty on submarine cables, but it was understood that the home manufacturers would be given the preference at equivalent prices.

The McKinley tarriff requires a duty on this article from every importer, Government or otherwise, but inasmuch as the duty is paid to the Government, an imported cable costs them no more than it did formerly.

All specifications for submarine cables for the Government that I have seen require gutta-percha as the dielectric, notwithstanding the fact that some of the best underwater cables are made with india-rubber. As there is but one manufacturer in this country who makes gutta-percha cables, and would probably take advantage of the protection to increase the price, the Government, it appears to me, in paying duty to itself, would naturally buy in the cheapest market.

If india-rubber cores were acceptable they could be manufactured here as well as abroad; in fact, many of our large companies have supplied underwater cables for a number of years, and, as far as I know, they have given satisfaction. I have a number of underwater cables running successfully under a pressure of 500 volts, and am now making some long lengths for the same pressure with a copper capacity of over 400,000 circular mils.

W. M. Habirshaw, F. C. S.

THE TROLLEY DOG FOR EUROPE.

One of our subscribers on the other side of the Atlantic was struck by the beauty and originality of the scheme for the utilization of waste animal power lately described in this journal under the heading of "The Trolley Dog." The genuineness of his interest is evidenced by the following questions, in regard to which he has asked us to communicate with the engineer of the plant in question: 1. What grades exist on the track? He thinks that abnormally steep grades could be overcome by this system. 2. What kind of feeder system is used? 3. Have the ears to be insulated, as in other trolley systems? 4. Is the motor noiseless? 5. Would a break in the trolley wire disable the motor? 6. What is the daily dog mileage made? 7. What are the running expenses per dog mile? 8 Have any patents been taken out on the system in Europe?

Some valuable data may be forthcoming in response to our correspondent's inquiries. The outlook for business in this direction in Europe would appear to be exceptionally good, for we hear that a company—the members of which are all owners of yellow dogs—is being organized to buy up every living yellow dog they can get hold of for future motor work, in order to monopolize the system in Europe. We fancy we hear with our prophetic ears the buzz of many trolley dogs over the water.

"THEY ARE MAGNIFICENT WORKS."

A reader in an Ohio city writes us: "Allow me to state that for the last two years I have been a subscriber to your paper, and have the several volumes, so far, bound. They are magnificent works, and I would not part with them or be without them. In fact in my estimation there is no electrical work of its kind that can outrank them."

FORTY-FIRST MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The Forty-First Meeting of the American Association for the Advancement of Science held at Rochester, N. Y., Aug. 16–23, was characterized by an unusually large and representative attendance. Over 150 new members have been elected since the Washington meeting. Nearly 200 papers were presented to the various sections most of them embodying the results of patient and thorough research.

As usual, excursions and evening entertainments formed no small part of the week's enjoyment. On Thursday evening a reception was given at the Powers Art Gallery and on Saturday excursions were arranged for Niagara Falls, etc. On the Tuesday following, the Physical Section by invitation of Dr. Nichols visited Cornell University, where unlimited pains were taken to exhibit the facilities which the physicist enjoys there.

It is rather lamentable that the number of papers read in the Physical Section was not large; the short session of but two days being somewhat indicative of the fact that the physicist is not doing what he should in the line of research. However, the shortness of the session was quite fully compensated for by the excellence of a majority of the papers presented, a few of which will be briefly outlined.

A photographic method of mapping the magnetic field, was the title of the first paper of Thursday's session presented by Prof. Chas. B. Thwing. The method consisted in sprinkling iron filings on a sensitized plate placed over a magnet in a dark room, then exposing to light, developing, etc.

Prof. Frank P. Whitman, in a brief paper on the "Magnetic Disturbances Caused by Electric Railways," gave the following results of recent observations: No magnetic instruments dependent on the earth's field can be used for reasonably accurate work at less than 1,500 feet from an electric railway, and the distance must be made greater still if the building in which the instrument is placed is fitted with a system of iron pipes. Minor galvanometers must use iron shields and artificial fields, while earth indicators and other similar methods of finding the constant of a ballistic galvanometer must be abandoned. Experiments are under way for providing the thinnest shield of soft iron which will serve as complete protection to magnetic instruments under such conditions as just mentioned.

A paper was read on the E. M. F. between normal and strained metals in voltaic cells, by Prof. Franklin. The E. M. F. of a Daniell cell was modified by placing under strain the copper wire employed as one of the plates. As soon as the wire became coated with a fresh deposit of copper, so that the surface was under normal conditions, the E. M. F. assumed its normal value although the wire underneath the coating was still under strain. When the wire was released the E. M. F. again became abnormal, but returned as soon as the wire had been again freshly coated with copper.

Among the papers that may be mentioned, in Friday's session, briefly, was one on "An Experimental Comparison of Formulæ for Total Radiation between 15° C. and 110° C." by Prof. Stevens. The total radiation formulæ of Weber, Stefan, Rosette and Doulong and Petit were discussed, and their variations shown by means of curves. Similar curves were shown, obtained from experimental data. An iron disc was used as a source of radiation and the thermopile method employed. The work was carried on in Prof. Weber's laboratory. On the whole Prof. Weber's formula, deduced from a careful study of Langley's work, was considered the rational formula, the others being exterpolations.

Prof. Snow presented three papers embodying the results of his two years' study abroad, just completed. The method employed in the first paper on the dispersion of radiations of great wave lengths in rock salt, silikite and fluorspar is due to Dr. Rubens. The method and results have already appeared in foreign periodicals. In his work on the distribution of energy in the arc, Prof. Snow projected the image of the arc on a large paper screen by means of a convex lens. A slit was cut in the screen between the images of the carbon points, which allowed to pass through only the radiation from the centre of the blue ball of the arc itself, the radiation from the carbons being entirely excluded. A spectrophotometer and bolometer were employed. Owing to the appreciable width of the bolometer wire, the bands ran into each other, so much so that the energy of each could not be separately determined. By means of the eye the spectrum was found to be not a continuous spectrum, not a band spectrum, but a spectrum of fine lines grouped together into bands. Although the energy in the ultra violet was extremely small, yet it was readily measured with a very delicate galvanometer of sensibility 1.5×10^{-11}, of 140 ohms resistance, with a double period of twenty seconds.

Prof. Snow's third paper was on the infra-red spectra of the alkalies. In this work the same methods as above described were employed, with the exception that cored carbons were used, the core being replaced by a salt of the metal to be tested, the chlorides being principally used. The salt of the metal boils and sends out a perfectly uniform stream of the vapor of the metal to be tested. Sodium was found to give some fifty or sixty lines. The only difficulty is to get the temperature high enough to see them. The arc does this readily. The principal sodium lines discovered were the well-known D lines, one just at the red end of the visible spectrum and one far out in the infra-red. These three groups were nearly alike, all the others being quite small in intensity. Potassium exhibited a rich field in the infra-red. With lithium there was absolutely no energy beyond the visible red end of the spectrum just after passing an extremely bright line. Many other salts were similarly examined.

Prof. Nichols gave a paper on the distribution of energy in the spectrum of the glow lamp. Two incandescent lamps of the same make were employed, connected so as to possess the same vacuum. The filament of one lamp was coated with carbon and the other was not. On the same voltage, the two lamps consumed the same number of watts, the carbon coating thus evidently furnished little or no conductivity. Under the microscope the treated carbon presented a rough surface, similar to a thick bark on a twig, consequently this lamp had a somewhat larger radiating surface. The lamps were tested throughout a great range of temperature, the lower temperatures probably being within the range of the mercurial thermometer. When the work is completed Dr. Nichols hopes to be able to express the law of radiation of carbon under the two conditions, treated and untreated, throughout its whole range of temperature. From this preliminary work the conclusions may be safely drawn that gray and black carbons differ in their distribution of energy and that the law of radiation does not vary sufficiently to appreciably shift the maximum. The linear thermopile and carbon disulphide prism were used in these as well as in the investigations by Mr. E. F. Nichols on the absorption spectrum of certain substances in the infra red, which paper was also presented.

Nelson H. Genung.

Society and Club Notes.

THE NORTHWESTERN ELECTRIC LIGHT ASSOCIATION.

The electricians, managers and officers of the electrical plants of the Northern Peninsula of Michigan and Northern Wisconsin effected on the 19th inst., an association at Marinette, Wis., at a well-attended and enthusiastic meeting, under the title of the Northwestern Electric Light Association.

The officers elected were: H. C. Higgins, of the Marinette Gas, Electric Light & Street Railway Co., as president; T. A. Pamperin, manager of the Citizens' Light & Fuel Co., and president of the Electric Manufacturing Co., of Oconto. Wis., as secretary; and Lewis Lusk, president of the Edison Electric Light Co., of Antigo, Wis., as treasurer. The directors, C. S. Leykom, Jas. R. Dee, F. B. Warren, A. A. Foreman and John F. Fitzpatrick, are gentlemen well known throughout the Northwest in the electrical business.

The object of the association will be the regulation, settlement and exchange of ideas concerning matters of mutual interest in the electrical business.

A number of honorary members were elected, including H. C. Hamilton, of Sault Ste. Marie, Canada; W. T. Sullivan, electrician of the Chicago Auditorium, and J. E. Bowers, president of the Crystal Falls board. After the adjournment of the meeting, the visitors, under the guidance and through the courtesy of President Higgins, inspected the well-equipped, well-regulated electric light plant and street railway under the management of that gentleman.

The next meeting will be held on October 12, at Oconto, Wis., at which full representation is looked for.

THE NEW YORK ELECTRIC CLUB.

After the period of nearly six months of depression, during which the board of managers have succeeded in liquidating the greater portion of the indebtedness of the club, it is a pleasure to notify the members that the restaurant and other full service of the club will be resumed on September 1.

A satisfactory arrangement has been made with Mr. W. V. Carter, caterer, who will undertake, from September 1, to supply members and their friends with meals, wines, liquors, cigars. etc., in quality and style of service equal to those of the best days of the club.

It is hoped that members will take an early opportunity to test the merits of the re-established restaurant; and that the opening night, September 1, will bring a houseful. Mr. Geo. F. Porter is now the assistant secretary and gives the club his close attention.

Mr. Joseph E. Lockwood, secretary of the Detroit Electrical Works, Detroit, Mich., spent a couple of days in Chicago last week. The works are very busy.

Letters to the Editor.

"CONTINUATOR" AND "PULSATOR."

I was greatly interested in the remarks by Mr. L. Gutmann, in your latest issue, concerning the expressions "continuous current generator" and "alternating current generator." Whenever they appear one is reminded of their wearisome length and simple meanings and of the want for something better.

However, the construction of substitutes is an important matter calling for considerable thought, and it is not easy to grasp just the right thing. The names "continuator" and "pulsator," as suggested by Mr. Gutmann, appear to me as hardly sufficient, inasmuch as they fail to convey the essential idea that the apparatus so named generates the currents pulsated or continuated. These names will equally as well refer to purely mechanical or non-generating devices—and there are several—which are used to pulsate a continuous current and to continuate a pulsating one. Of course, in this instance, it is absurd to designate the current as, in an electrical sense, nothing else can be pulsated or continuated.

Having appeared in The Electrical Engineer, Mr. Gutmann's excellent and timely article will be considered by every one in a position to do so, and it will, I hope, be the means of abandoning the old clumsy expressions referred to; but, giving him all due credit, I think something other than "pulsator" and "continuator" will be required to make a proper substitute.

Harry L. Tyler.

Corning, N. Y., Aug. 20, 1892.

Personal.

MR. NIKOLA TESLA.

This distinguished electrician has returned to New York, arriving by the "Augusta Victoria," from Hamburg, on August 27. Mr. Tesla sustained a severe bereavement while in Europe in the death of his mother, and was obliged to rest for some time. His magnificent reception at the hands of European electricians has become, like his inventions and researches, part of electrical history; and the honors conferred on him were such as to make Americans very proud of one who has chosen this country as his home.

Mr. R. S. Dobbie, fomerly with the Engineering Department of the Edison General Electric Company, has opened offices in the Times Building, New York. Mr. Dobbie will be glad to see his friends there and may be consulted in reference to new apparatus, inventions, designs, etc. As an old central station man, Mr. Dobbie is also ready to consult in regard to the construction and installation of new plants for lighting and power purposes.

Mr. Dobbie has had an intimate experience with United States, Thomson-Houston, Brush and Edison apparatus, and has made a particular study of designing and testing new apparatus. His card as consulting electrical engineer is to be found in our advertising pages.

Mr. F. A. Phelps, Jr., late mechanical engineer at the Schenectady Edison Works, has resigned that position to become associated with Mr. Edison more directly in the latter's various new enterprises, in which Mr. Phelps's ability will find abundant scope.

THE PLANT OF THE UNION POWER CO., PORTLAND, ORE.

Early in 1891 the Union Power Company was formed in Portland, Ore., for the sole purpose of furnishing power. In carrying out this purpose the company has adopted some devices which have been used before, but had also been obliged to do considerable pioneer work. It is the writer's purpose to speak of this latter more particularly. The revenue of the company is derived from the operation of two street railways, the City & Suburban Railway Co., and the Multnomah Street Railway Co., and from a large number of stationary motors.

The plant consists of one cross-compound condensing engine, Corliss type, of 1,200 h. p., one Buckeye engine of 500 h. p., a battery of ten boilers and seven 175 K. W. dynamos. In order to obtain cheap fuel a piece of ground was purchased, containing three acres, near a large sawmill, on which the plant was erected. The distance from sawmill to plant is 1,600 feet. The fuel used is sawdust and the edgings from the lath mill, which are previously broken up by a "hog." It was found that 1,600 feet was too long a distance to blow this refuse with economy; a carrier was therefore devised, similar to the ones used in mines, which receives the refuse, carries it to the stock house and there automatically dumps it. From this stock house another carrier takes the fuel across the tops of the boilers and dumps it into the fireboxes, as required by the attendant. The whole operation necessitates the employment of but two men on a watch, to care for the ten boilers. The power required for the conveyers is furnished by a 25 h. p. engine, which also pumps the water for the boilers into a tank from which the boiler pump takes it, passing it through a heater before forcing it into the boilers. The smallest estimate for blowing the amount of fuel required for this plant was 80 h. p.

There is nothing particularly novel about the steam plant but the transmission, both from engine to countershaft and from countershaft to dynamos is entirely by ropes on the Dodge system with single wrap. The double wrap was tried at first but was not entirely satisfactory and was changed to the single wrap. The system of transmission by ropes is now giving excellent results. One marked improvement is the almost entire absence of noise, a point spoken of by all who have had experience with belt-driven machinery. It is too early to give any definite figures as to depreciation and renewals but at present they are believed to be less than for belts.

The seven dynamos are connected, five to the large engine and two to the small one. The switchboard is arranged for the three-wire system or the two-wire system, as may be desired. Any dynamo may be thrown on either of the railways or on either side of the power circuit. The complete interchangeability of dynamos has proved of great benefit when occasion has arisen for stopping a dynamo from any cause. It is also possible to connect the dynamos so that the entire load may be thrown on both engines at the same time, by which an overload on either engine can be at once checked; necessity for this often arises on holidays. When running with load on both engines the voltage of dynamos on either engine can be held constant within one-half of 1 per cent or increased at will by over-compounding. This result is the more remarkable as one engine runs at 72 revolutions while the other runs at 130 revolutions per minute and no trouble is experienced in making each dynamo carry its proportion of the load and no more. All power is furnished on the three-wire system both to railroads and stationary motors, as the plant is three miles from the centre of distribution.

The results obtained have been very gratifying. The charges to the railroads are based on readings of Thomson wattmeters in each railroad circuit and are at a fixed price per horse power per month. These meters have given good satisfaction. A reading is taken daily and the meters have been found to respond accurately to any increase in load by addition of cars, or to extra load due to holidays. Ampere readings of circuits are taken hourly, from which it appears that the maximum load on street car lines is slightly more than twice the average load.

The stationary motor business has proved very satisfactory and the company has in addition to the usual motors running printing presses, fans, etc., installed a number of plants for operating hydraulic elevators using pumps and motors connected by belts. Formerly these elevators were operated from the city water mains but the cost was so great that the owners changed to electric means of working them, with a decreased cost to themselves and a much better service to the occupants of their buildings. These outfits have been furnished to pump into compression tanks and also to tanks on the roof. The cost to consumers has been found to be much less than for running steam pumps and the company has replaced several of these as well. The writer has made tests as to power consumed in operating different sizes of pumps under different pressures when pumps were operating elevators and finds them very satisfactory.

The company is also supplying power for running motors, operating generators, supplying light for large buildings and block lighting, to the extent of some 2,000 16 c. p. lights, and this from a plant operating some fifty cars at the same time on same engines and with perfect results as to uniform pressure. The plant was originally planned to run five dynamos but, while in operation about a year, it has been necessary to add two more of the same size and still the demand for power has about taken up the capacity of these latter machines.

H. E. C.

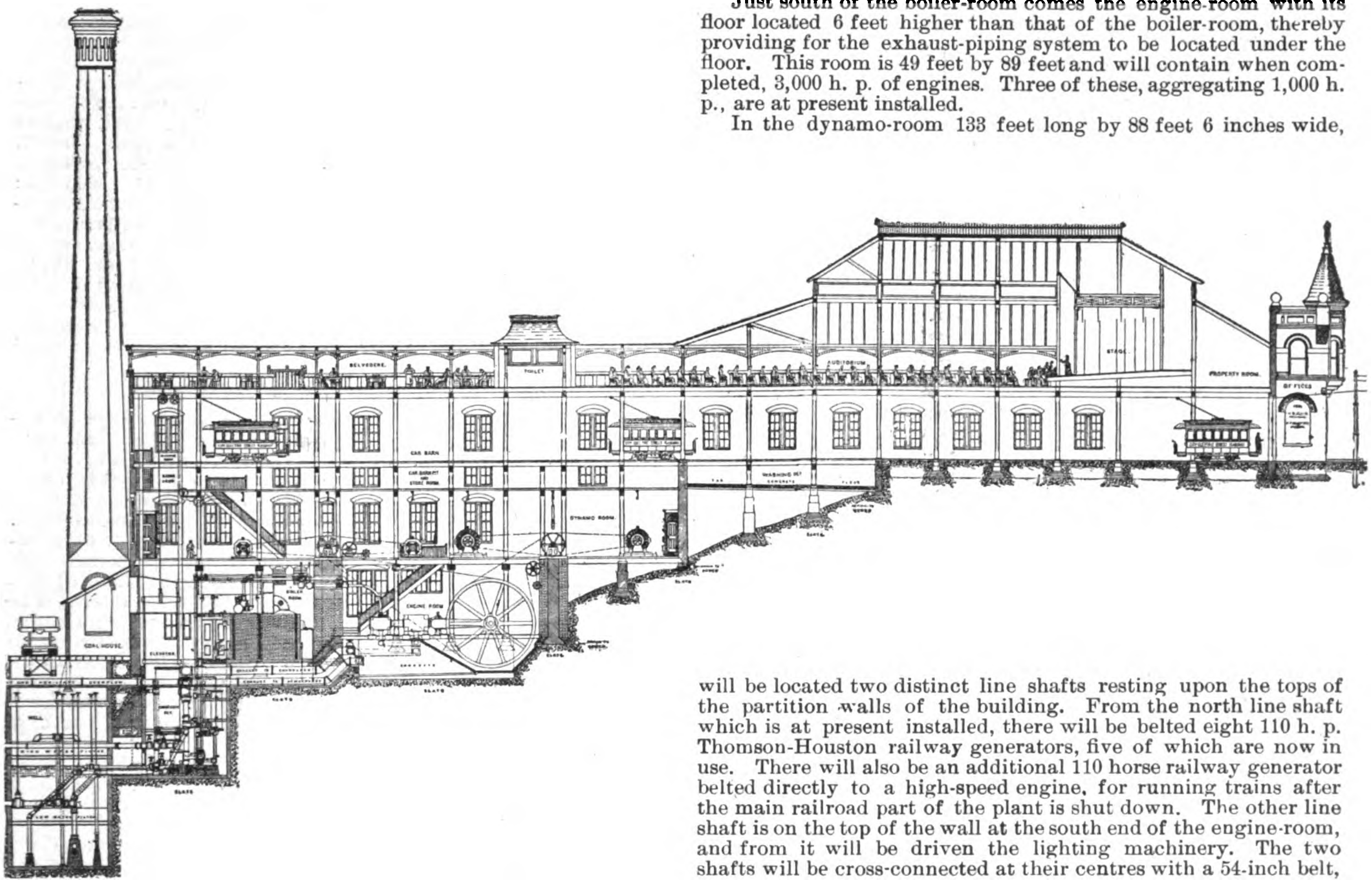
AN ELECTRIC GRAIN BIN INDICATOR.

An electrical device has recently been designed for the purpose of assisting men employed in elevators to tell when the bin is full. The apparatus comprises an electric battery, a bell and a diaphragm which is placed in the bin at a distance of about 18 inches from the top. This diaphragm is connected by wires to the battery and bell and when the bin is full the fact is indicated by the ringing of the bell, which continues till it is cut out by a switch provided for the purpose, the bin being also indicated by the number of the switch which corresponds to it or by a point annunciator. This device can also be applied to telling the amount of grain in the bin, which is now done by lowering a lighted lamp into the bin by a rope. Electric grain bin indicators have been placed in Armour & Co's. elevator, Chicago, by Mr. E. Sherlock, who is interested in the invention, with Newton & Co., of Aurora, Neb. This apparatus is worthy of investigation by elevator men and others as its introduction saves an immense amount of trouble and labor.

THE ELECTRIC STREET RAILWAY SYSTEM OF LITTLE ROCK, ARKANSAS.

On April 1, 1890, Mr. H. G. Allis, president of the First National Bank of Little Rock, Arkansas, to whom Little Rock is indebted for its electric street railway service, organized the Capital Street Railway Company, and secured authority from the city council to propel their cars by electricity. A short time later Mr. Allis secured control of the City Electric Street Railway Company and the other lines were then leased to this company. In October, 1891, the company closed a contract with the Thomson-Houston Electric Company to equip the system with electricity. The local company built its own power house, track and road-bed. Mr. H. P. Bradford, general manager of the company, personally superintended the construction of the road-bed and track. The Thomson-Houston Company's contract work, consisting of the overhead construction, and the installation of the electrical machinery was placed in charge of Mr. E. E. Downs, one of the constructing engineers of that company.

The engineering of the power station was placed in charge of Mr. B. J. Arnold, consulting engineer of the Chicago office of the Thomson-Houston Electric Company, who designed the plant and superintended its construction. Mr. Arnold was assisted by Messrs Rickon & Thompson, architects, of Little Rock, Arkansas. The road is now operating twenty 30 h. p. motor cars and six trailers and is using 12 tons of slack coal, costing $1.70 per ton, per day of 24 hours' run, or less than one-half ton of slack coal per car per day. The cars operate for 18 hours per day but the small electric light engine, running 18 arc lights for lighting the car barns and summer theatre, is run all night and this fuel consumption is included in the above amount.



Power House of the Little Rock Street Railway Company.

There are about 20 miles of track of 35-pound steel T-rail and 52-pound Johnson girder rail placed on chairs. The track is bonded throughout with No. 6 bond wire, joined to the rails with the Wheeler channel pins, and the ground wires are attached to old car wheels and other metal plates which are sunk in the old wells and ravines at suitable intervals along the road. About 20 miles of No. 0 hard-drawn copper wire was used for the trolley system or the road in addition to about 40,000 feet of No. 000 insulated wire for feeders. The trolleys and feeder systems are supported upon about 1,400 poles, 100 of which are Milliken latticed iron which are used through the business portion of the city. The thoroughness of the electrical work will be appreciated when it is known that the first time the current was sent out over the line not a ground was discovered or any defect in the electrical construction noticed.

The power house, a sectional elevation of which is shown in the accompanying illustration, is located on the Arkansas River on the site where the water-works plant formerly stood. The main line of the St. Louis, Iron Mountain and Southern Railway runs along the river bank in the rear of the building, enabling a side track to be built cheaply and fuel delivered directly into the coal house with but one handling. The boiler-room is 44 feet by 89 feet by 25 feet high. In it will be placed, when the plant is completed, eight 250 h p. water-tube boilers, three of which are at present installed. Over the top of these boilers is a sheet-iron breeching extending to the space between the centre row of columns where they join the main trunk breeching leading to the smokestack located outside the main building. The plant is at present operated from an iron stack 5 feet 6 inches in diameter and 180 feet high, set off to one side so that the permanent brick stack can be constructed in its proper position without interrupting the operation of the plant. The permanent stack will be built of brick and will be 84 inches in diameter by 180 feet high.

Just south of the boiler-room comes the engine-room with its floor located 6 feet higher than that of the boiler-room, thereby providing for the exhaust-piping system to be located under the floor. This room is 49 feet by 89 feet and will contain when completed, 3,000 h. p. of engines. Three of these, aggregating 1,000 h. p., are at present installed.

In the dynamo-room 133 feet long by 88 feet 6 inches wide, will be located two distinct line shafts resting upon the tops of the partition walls of the building. From the north line shaft which is at present installed, there will be belted eight 110 h. p. Thomson-Houston railway generators, five of which are now in use. There will also be an additional 110 horse railway generator belted directly to a high-speed engine, for running trains after the main railroad part of the plant is shut down. The other line shaft is on the top of the wall at the south end of the engine-room, and from it will be driven the lighting machinery. The two shafts will be cross-connected at their centres with a 54-inch belt, enabling any generator in the house to be driven from any engine in case of accident to any other engine. The railroad switchboard is at the north end of the building and the lighting switchboard in the south end so that the leads from dynamo to switchboard may be as short as possible, and also to keep the railway and lighting plants distinctly separate. Over each row of generators and the line shafting, extends an overhead single track railroad with the necessary differential pulleys, etc., for the lifting out of armature or box caps. This railway runs to the elevator shaft so that the heavy part may be delivered directly into the elevator and transferred to the machine shop above with but little labor.

On each side of the dynamo-room are stairways extending up to the pit-room above, placed there to provide for easy access to the motors and cars for making repairs at all times without necessitating the changing of position of the cars. Extending 50 feet south of this pit-room is the washing pit running the entire width of the building under all of the tracks so that cars from either track can be run over the pit, washed, drained and run back to their places without any transferring.

The car barn, 88 feet 6 inches wide by 297 feet long contains eight tracks 4 feet 8½-inch gauge and is capable of storing 96 motor cars, and on top of the car barn roof has been built a theatre and garden, capable of seating an audience of 1,000 people in the auditorium proper and about 400 around the tables and places of amusement in the belvedere.

STATION OF THE HULL ELECTRIC LIGHT AND POWER COMPANY, HULL, MASS.

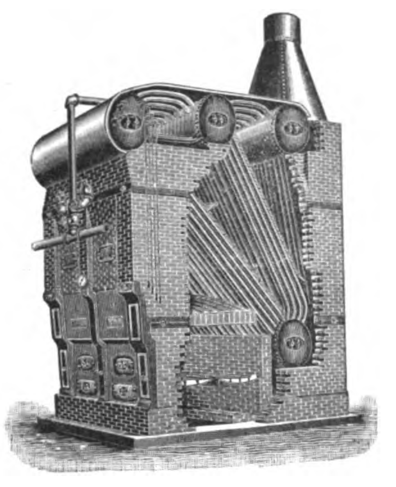
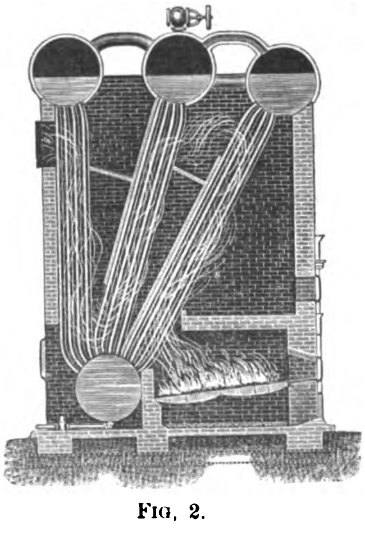


Fig. 1.—Stirling Boiler.

The Hull Electric Light and Power Company was organized about a year ago, but up to a very recent date, nothing was done in the way of construction, owing to various circumstances over which the company had no control. A few months ago, however, it was decided to proceed with the station, and there is now being built a short distance from Hull, a station which will be perfect in every detail, and which will possess some interesting new features. The company has the contract for lighting the town of Hull, with incandescent lights, and has besides many contracts for lighting the numerous hotels and private residences in Hull and along the shore to Nantasket, and it is their intention to make the station a model one in every respect. The engine-room, which is of wood, measures 40 feet by 50 feet, and will contain three Fitchburg cross-compound condensing engines, two being of 160 h. p., and one of 125 h. p. The larger engines will have fly-wheels 8 feet in diameter by 14-inch face, and the smaller one 66-inch diameter by 14-inch face, and there will be no countershafting, the engines belting direct onto the generators. Wainwright heaters will be used, and Deane steam pump and condensers. The generators will be at present two of the latest type Westinghouse alternating incandescent dynamos, one having a capacity of 1,000 lights, and one of 2,000. These generators will be equipped with the latest type of toothed armatures, and composite field winding, which will render them perfectly automatic, so that any number of lights can be turned off and on at will without affecting the others. The advantage of the toothed armature is that by this means the station is effectually protected from any complete shut-down of the plant, on account of the armature coils being easily removable in case of damage when they can be readily repaired by the employees of the company. The switchboard will be of the latest improved design and will contain the usual Westinghouse voltmeters and ammeters and other necessary apparatus. One of the most interesting features of the station is the boiler-room, which is built of brick 30 feet square, and which contains two 150 h. p. Stirling water tube safety boilers in one battery, which are worthy of a detailed description and of which two views are shown in Figs. 1 and 2. The Stirling boiler consists simply of two or more upper wrought steel drums connected with each other and with a lower or mud drum, also of steel, by tubes expanded directly into the drums. This comprises the whole boiler, not an ounce of cast iron or cast steel being used in its construction. The importance and value of this latter quality will be readily recognized and promptly conceded by all competent authorities, as it has been the aim of all boiler makers to eliminate cast iron from boilers for many years. As will be seen, the tubes sit in a nearly vertical position, thereby preventing any deposit on the inside of the tube or soot on the outside, and enabling the gas currents to pass around in such a manner as to utilize all their heat energy. The flame by means of brick partitions follows a tortuous passage up and down the length of the tubes, heating the water very rapidly through the thin tubes. Owing to its construction the Stirling boiler has a very large grate surface, a good draught, and perfect combustion is obtained, making it one of the most economical boilers on the market. Each tube is expanded directly into the circulating drums, furnishing its own outlet, allowing for expansion and contraction, and allowing a perfectly free circulation.



Fig, 2.

An additional precaution is also taken by making a bend on each tube in case of unequal expansion of any member in one group. The accessibility of these boilers for cleaning is also notable, as by opening one manhole in each drum, access is gained to every part of the interior of the steel plates and to both ends and the interior of every tube. These boilers, which are manufactured by the Stirling Company, of Chicago, and installed by their Eastern agent, Mr. J. Bradford Sargent, of 620 Atlantic avenue Boston, have already attained a high reputation, as being safe, highly economical, and satisfactory in every way. We append a list of a few electric stations in which they may be seen working to advantage: The Tiffin Illuminating Company, Tiffin, Ohio, 150 h. p.; American Water Works and Guarantee Company, Pittsburgh, Pa., 200 h. p.; Lyon, Clements & Greenleaf, Wauseon, Ohio, 150 h. p.; Bell Telephone Company, Philadelphia, Pa., 142 h. p.; Edison Electric Light Company, Altoona, Pa., 200 h. p.: Hughes & Gawthrop, Pittsburgh Pa., 60 h. p.; Second Avenue Electric Railway Company, Pittsburgh, Pa., 200 h. p.; Wilkinsburgh Electric Illuminating Company, 150 h. p., second order 450 h. p.; Jamestown Street Railway Company, Jamestown, N. Y., 300 h. p; Akron, Ohio, Electric Company, electric lighting, 600 h. p., second order 200 h. p.; Jones Bros. Electric Co, Cincinnati, Ohio, 300 h. p.; Auburn Mining Company, electric lighting, Auburn, Ind., 125 h. p.; San Francisco and San Mateo Electric Railway Company, San Francisco, Cal., 1,250 h. p.; Conneaut, Ohio, Electric Company, electric lighting, 160 h. p.; Los Angeles, Cal., Consolidated Electric Railway Company, 1,500 h. p; Indiana, Pa., Electric Company, 100 h. p.; C. S. Robinson, Princeton, N. J., 100 h. p.; Waco, Texas, Electric Co., 300 h p.; San Antonio Rapid Transit Street Railway Company, San Antonio, Texas, 200 h. p.; Edison Light Co., Grand Rapids, Mich., 400 h. p.; Minneapolis Street Railroad, Minneapolis, 575 h. p., second order 2.000 h. p.; Gray Electric Company, Highland Park, Ill., 75 h. p.; Grand Forks, N. D., Gas and Electric Company, 82 h. p.; Mahoning Electric Light Company, Youngstown, Ohio, 150 h. p.; Brush Electric Company, light and power, Cleveland, Ohio, 500 h. p.; Grand Rapids, Mich., Electric Company, 400 h. p.

ELECTRIC ILLUMINATIONS IN ST. LOUIS.

It has been customary for several years past to have an exceedingly elaborate series of fall festivities in St. Louis commencing September 1. This year one of the most important features will be the electric light pieces in some of the principal streets. This work has been placed in the hands of the Emerson Electric Manufacturing Co. who have handled it in the most able manner.

On 12th street between Market and Chestnut they have arranged a model of the vessel "Santa Maria" placed upon an arch across the street having a span of 60 feet and being about 30 feet in height and at least 60 feet to the topmasts of the vessel. The illumination of this piece is effected by 1,800 incandescent lamps of various colors, and a moving effect is given to the waves by an automatic switching device which cuts the lights in and out. Over the Grant statue on 12th street near Olive is erected a flag arch with the United States flag and the flag of Castile and Leon crossed above the statue and lighted by one thousand 16 c. p. lamps.

The most striking of the illuminations, however, is a display forming practically a panorama of the discovery of America. It comprises a globe upon a pedestal 125 feet high with the outlines of the New World clearly defined by incandescents and lines representing the equator, tropics and poles similarly illuminated; the former in white lights and the latter in arranged colored ones. By means of a commutating arrangement operated by a Meston alternating current motor, the outside circle of the globe is first lighted with the red, white and green lamps then the geographical lines. Next a small star appears at San Salvador, and simultaneously the date 1492. Gradually the march of discovery will be depicted by the lamps until the entire continent is outlined by myriads of lights, and the name St. Louis and date 1892 appear. More than 1,300 lights are used in this display.

There are also two additional electrical arches one on Olive street near 13th street, and the other at 17th street, the first a transparency of Columbus and the second a pyrotechnic arch with moving lighting effects. From 600 to 800 lights will be employed on each of these. Something like 600 to 800 h. p. will be required to furnish the current for all these lamps. Alternating current will be used and the little Meston alternating motors are here to be seen furnishing the power for the commutating cylinders. All the work has been carried out in the best and most artistic manner and reflects great credit on the Emerson Company both from the thorough way in which it has been done and the novelty and beauty of the effects produced.

ONE HUNDRED THREE TIMES.

One hundred new locomotives, one hundred new sleeping cars, and one hundred-pound steel rails, seems a rather trifling coincidence, but it is of great interest to patrons of the N. Y. C. & H. R. R. R.

THE CAR OF THE COMBINATION CAR COMPANY.

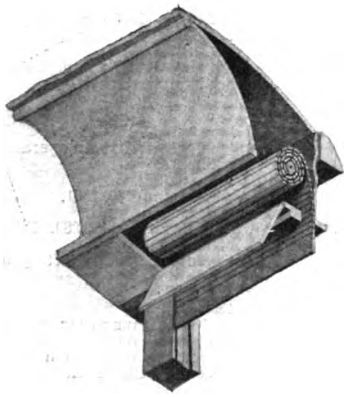


FIG. 1.—SECTION SHOWING AUTOMATIC ROLLER.

THE accompanying illustrations show the combination car which has been in constant service on the electric street railway between Newton and Waltham, Mass., and which has attracted wide attention among street railway men, owing to its many new and important features. Fig. 2 shows the full view of the car, from which it will be seen that it resembles in almost all respects an ordinary first-class eight-wheeled car, the only noticeable feature being the extra large size of the windows. The windows are patented, and, as will be seen, are divided horizontally in the middle, so that both halves can be readily let down into the pocket in the panel of the car. When the windows are thus let down the car has all the appearance of an open car, the sill of the window coming very low down and allowing a perfectly free circulation of air. Fig. 3 shows the inside of the car, and shows the seats, which are set across the car, like most open cars, instead of lengthwise, as in all closed cars. This is a most desirable feature, and has proved a wonderful attraction to many of the residents of Newton and Waltham. This view of the car also shows the slat roller blind, for use either when the sun proves too powerful for comfort, or in case of a moderate breeze or slight rain. Fig. 1 shows the automatic roller in section, from which it will be seen that the slat blind can be rolled up or down at the will of the passenger, much in the same way as an ordinary window shade. From the above description it will be readily seen that the combination car can be instantly transformed from a closed box car into an open summer car, and that in addition any degree of openness may be attained by manipulating the windows or the shades. The car has proved a remarkable success in every way, and is well worthy of inspection by electric railway companies, who can save a large amount of rolling stock by having those cars in place of two complete sets of closed and open cars. The patents on this car are owned by the Combination Car Company, of 23 Court street, Boston, who will gladly furnish any further information.

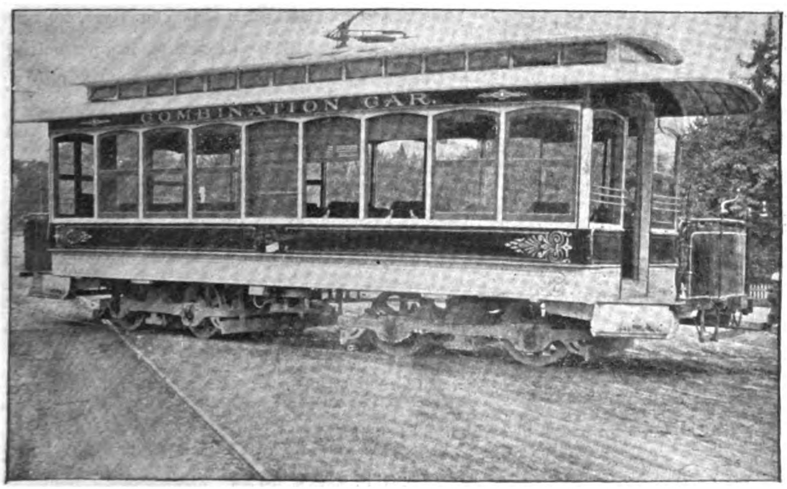


FIG. 2.—EXTERIOR OF COMBINATION CAR.

ELECTRIC TRACTION IN MONTREAL, CAN.

A SHORT time ago the Montreal city council invited tenders for the privilege of operating street railways by electricity in that city, in response to which tenders were received from several syndicates representing American and Canadian capitalists. After many meetings of the council and much virulent discussion of the merits of the different tenders, the contract was awarded to the Montreal Street Railway Co. on July 19th, their tender being considered the most advantageous. Considerable partisanship was manifested, and the mayor, who favored another tender, declared he would not sign the contract; but the company claim this can be dispensed with. This company, who at present operate the horse railway system in the city, will now have the exclusive right to propel cars by electricity on the principal thoroughfares for the next 30 years, in consideration of which they agree to the following conditions:

The company is to pay the city annually 4 per cent. of its gross earnings up to $1,000,000; 6 per cent. of its gross earnings from $1,000,000 to $1,500,000; 8 per cent. of its gross earnings from $1,500,000 to $2,000,000; 10 per cent. of its gross earnings from $2,000,000 to $2,500,000; 12 per cent. of its gross earnings from $2,500,000 to $3,000,000; 15 per cent. of its gross earnings above $3,000,000.

It is also to sell six tickets for 25 cents, 25 tickets for $1, and, to school children, 10 tickets for 25 cents. Tickets available between 6 and 8 a. m. and 5 and 7 p. m. to be sold at the rate of 8 tickets for 25 cents. Single fares to be five cents and transfers given to all routes without charge.

Mr. H. A. Everett, well known in connection with the Cleveland and Toronto electric railways, has been appointed managing director of the company and will have charge of the introduction of electric traction. In addition to the present routes, which will be relaid with English grooved rails, new routes will be established through other parts of the city. Work has already been commenced and it is expected that electric cars will be running on at least one of the routes by the end of September next.

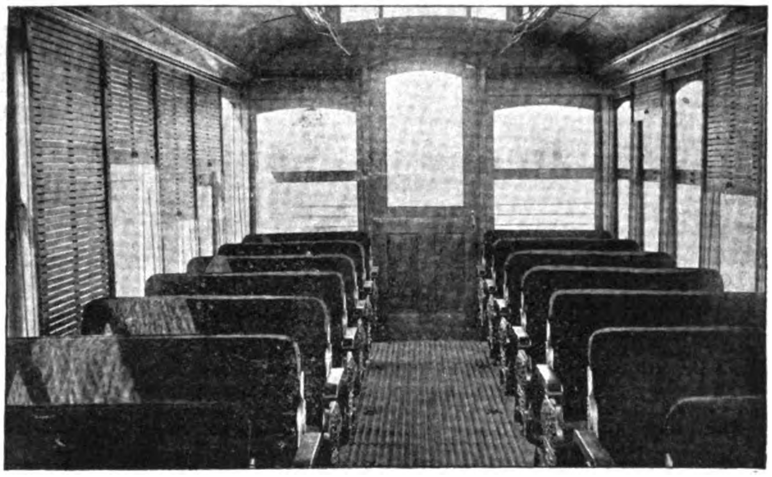


FIG. 3.—INTERIOR OF COMBINATION CAR.

The trolley system will be used, and the company estimate that it will cost $1,500,000 to introduce this system exclusive of any loss on the old equipment. The cars will be heated and lighted, and of the most improved type, and provided with single-reduction motors. As for nearly four months of the year the Montreal streets are covered with snow, often to a depth of two or three feet, the operation of the cars in winter is an important problem and has received careful consideration. In order to enable the electric cars to run all winter, the snow will be removed from the entire roadway of the streets on their routes, leaving a layer of sufficient depth for sleighing (say 8 or 10 inches) and the tracks will then be kept clear by the use of sweepers and plows. The city and company are to share in the expense of removing the snow which will be done after each snowfall of any depth, when it can be done most easily.

At present the horse cars run for about eight months of the year, and during the remaining time sleighs or stages are used; the stages being used when the streets are not in good condition for sleighing. At times, owing to the bad state of the streets, the stages or sleighs go at a speed but little faster than a walk, so that the citizens generally are much pleased at the prospect of having electric cars that will run all winter and give a rapid and reliable transit in spite of the snow or impassable condition of the streets.

Line and other material, including 80 cars, have already been ordered, which latter are to be equipped with two 25 h. p. motors each, in order to have ample power for ascending grades. These motors have been ordered of the Royal Electric Co., who have gotten up a single-reduction motor of their own design, embodying many improvements. For the present, this company (the Royal) will furnish the power for running the cars from their lighting station and are building eight 250 h. p. generators for this purpose.

The poles of the Bell Telephone Co. and those of the Royal Electric Co. are being used for the suspension of the trolley wire as far as possible. The work is being pushed forward rapidly; the Royal Electric Co. are working night and day in order to furnish the material ordered of them on time, and are using their new building, which is equipped with the most improved machinery.

L. M. P.

Inventors' Record.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED AUG. 9, 1892.

Accumulators:—

Secondary Battery Plate, E. R. Knowles, 480,266 Filed Oct. 15, 1891

Composed of an alloy of lead, tin, antimony and arsenic.

Electric Acumulator, G. Gandini, 480,575, Filed April. 15, 1891.

Employs electrodes formed with a mixture of lead outside and small pieces of carbon having a thin top layer of lead outside, a porous partition separating the electrodes.

Alarms and Signals:—

Electric Bell, G. W. Conover, 480,319. Filed Oct. 31, 1891.

A bell or buzzer in which the operating bar is fastened to the cover and removable from the base.

Burglar-Alarm, F. H. Neal and J. R. Donnelly, 480,340. Filed March, 7, 1892.

Has for its object to limit the ringing of the alarm to the time during which the door or window is being opened and closed.

Block Signal Apparatus, T. H. Patenall, 480,411. Filed Feb. 10, 1892.

Consisting of electrical block signals for steam railways.

Electric Low-Water Alarm, E. Rothlisberger, 480,673. Filed April 18, 1892.

Conductors, Conduits and Insulators:—

Conduit for Electric Wires, S. H. Flagg, 480,573. Filed Jan. 26, 1889.

Conduit consisting of a metal pipe lined with glass.

Distribution:—

System of Electric Lighting, G. F. Myers, 480,372. Filed Dec. 15, 1891.

A system of electric lighting for use in connection with cable railway.

Electric Lighting System, C. Selden, 480,375. Filed April 9, 1892.

Employs a Wheatstone bridge interposed in the main line wire to supply a definite current to the translating devices connected in the bridge wire.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, H. H. Dow, 480,384. Filed April 4, 1892.

Employs a zinc element, a bibulous sheet moistened with the electrolyte and a layer of finely pulverized carbon.

Electrolytic Cell. E. B. Cutten, 480,491. Filed Aug. 19, 1891.

Claim 2 follows:

The combination of an outer tank, an annode therein consisting of carbon pencils projecting from a carbon bar and a protecting trough enclosing said bar.

Lamps and Appurtenances:—

Incandescent Electric Lamp, P. Scharf, 480,284. Filed Aug. 7, 1891.

Has for its object to dispense with platinum leading-in wires.

Arc Lamp, C. Schmid, 480,285. Filed Dec. 7, 1883.

Claim 1 follows:

In electric arc lamps the combination with the carbon holder of the mechanically suspended retaining clamp and the trip-feed co-acting mechanically at determined intervals to release said clamp.

Supporting Device for Electric Arc Lamps, J. Maier, 480,470. Filed Dec. 11, 1891.

Electric Arc Lamp, E. A. Sperry, 480,525. Filed June 7, 1890.

Provides means for automatically re-establishing an arc which has been extinguished.

Support for Electric Arc Lamps, A. Wright, 480,539. Filed April 27, 1891.

Metal Working:—

Method of Electric Soldering, E. Thomson, 480,392. Filed Aug. 22, 1887.

Miscellaneous:—

Method of Electrical Regulation, H. E. Vineling, 480,393. Filed Feb. 23, 1892.

Employs a primary electric magnetic regulator and a supplementary regulator provided with adjustable means for varying the current supply which actuates the primary regulator.

Method of Electrolytically Producing Potassium Chlorate, E. B. Cutten, 480,492. Filed April 11, 1892.

Method of Electrolytically Producing Potassium Chlorate, E. B. Cutten, 480,493. Filed April 11, 1892.

Circuit Closing and Breaking Device for Railway Tracks, F. H. Pattenall, 480 507. Filed Oct. 20, 1891.

Employs a reciprocating plunger operated by the passing train and completing a circuit by engaging with two contact plates.

Automatic Mileage Recorder for Car Seats, H. S. Squires, 480,526. Filed Dec. 8, 1891.

Electric Door Opener, L. Bates, 480,546. Filed Aug. 13, 1891.

Method of Apparatus for Testing Circuits for Electric Time Systems, W. F. Gardner, 480,576. Filed Jan. 7, 1891.

Clock Synchronizing Device and System, W. F. Gardner, 480,577. Filed Dec. 13, 1888.

Electric Fuse Box, G. W. Baumhoff, 480,651. Filed Dec. 16, 1891.

Consists in interposing pieces of non-fusible between the fuse and the means of attachment.

Dental Engine, C. W. Thomas, 480,678. Filed Oct. 21. 1890.

Electrical Spool, S. S. Wheeler, 480,681. Filed Dec. 30, 1891.

A sleeve or spool for an electromagnet.

Electric Push, J. F. Wollensak, 480,683. Filed May 10, 1892.

Railways and Appliances:—

Closed Conduit for Electric Railways, A. L. Lineff, 480,409. Filed June 30, 1891.

Employs a series of separate supports for the conductor provided with downardly projecting annular lips and a continuous series of tiles serving as a base for said supports and provided with oil troughs into which the annular lips enter.

Electric Railway, F. B. Badt, 480,543. Filed Dec. 19, 1891.

Relates to means of supplying current from underground conductors to the moving car on the surface.

Switches and Cut-Outs:—

Time Cut-Out for Electric-Service Systems, S. R. Linville, 480,369. Filed March 29, 1892.

Consists of a time-controlled switch for automatically short-circuiting or breaking a lamp, motor, etc., at a required time.

Electric Switch, J. S. Gibbs, 480,694. Filed Feb. 27, 1892.

Employs fixed and movable poles supported upon a base, a handle connected with the movable pole through a train of multiplying gears.

Telegraphs:—

Telegraph-Key, A. E. McClaren, 480,475. Filed Apr. 9, 1892.

A key designed for use in connection with all the wires that an operator can handle dispensing with a multiplicity of instruments.

Duplex Telegraph, T. A. Edison, 480,467. Filed Sept. 1, 1874.

Telegraph-Transmitter, C. Willoughby, 480,644. Filed June 30, 1891.

Employs a bank of keys one for each letter or character desired.

Automatic Circuit-Closer for Telegraph-Keys, C. W. Bradford, 480,669. Filed May 31, 1892.

Has for its object to prevent the circuit from being accidently left open.

Telephones and Apparatus:—

Telephone, J. A. Christy, 480,656. Filed Dec. 1, 1890.

Employs a wire gauze screen over the mouth of the transmitter, an insulating washer resting on the screen, a diaphragm resting on the washer, a metal washer set upon the diaphragm having electrical connection with the exterior of the case and an insulating washer set upon the metal washer

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CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED AUGUST 16, 1892.

Accumulators:—

Storage Battery, E. P. Usher, 480,883. Filed Aug. 22, 1891.

Employs a flexible wrapper for the series of plates having inwardly projecting inclined lips to hold the separator sheets and lead plates in proper alternate position,

Storage Battery, E. P. Usher, 480,885. Filed Feb. 19, 1892.

Employs separator plates of kiln-dried wood applied directly to the face of the positive plates, while an open space is left between the separator and the negative plates.

Battery Plate, E. P. Usher, 480,886. Filed Feb. 19, 1892.

Consists of a tablet of lead oxide or its equivalent formed of a wrapper of lead foil, and a filling of dry powder with a conducting strip embedded therein and protruding therefrom.

Battery Plate, E. P. Usher, 480,887. Filed Feb. 19, 1892.

Employs a marginal frame with open interior spaces and one or more cross-bars, one side of the frame and bars being coa'ed with an adhesive substance to which adheres a leaf of lead foil. The spaces are then filled with powdered oxide of lead and another leaf of foil similarly fastened to the other side of the frame.

Alarms and Signals:—

Electrical Drop Annunciator, T. W. Lane, 480,729. Filed Dec. 19, 1891.

Electric Train Signal, G. Merritt, 481,042. Filed April 18, 1892.

An electric cord signal system for steam railways.

Conductors, Conduits, and Insulators:—

Insulator, W. J. Bowen, 481,132. Filed May 2, 1891.

Consists of a hollow shell containing an insulating material and having an eye extending through the shell, to which the conductor is connected.

Distribution:—

Electric Lighting System, M. J. Quirk and C. Bach, Jr., 480,782. Filed Oct. 29, 1891.

A concealed system of switches for operating lights in large buildings.

Dynamos and Motors:—

Armature Conductor and Means for Insulating the same, E. Kolben, 480,727. Filed Feb. 8, 1892.

A conducting bar serving as a commutator bar and having a continuous sheet of insulation on its two sides and rear edge.

Ring Armature, E. Kolben, 480,728. Filed Feb. 8, 1892.

An armature having a conductor comprising its coil bare on two opposite sides of the armature, whereby either side may be employed as a commutator surface.

Commutator for Electromagnetic Machines, H. F. Parshall, 480,73). Filed Dec. 11, 1891.

Employs conductors connecting separate segments of the commutator, each of said conductors having sections in separate parallel planes.

Armature for Dynamo-Electric Machines, H. F. Parshall, 480,740. Filed Dec. 11, 1891.

Claim 2 follows:

An armature core built up of alternating sections of notched and perforated plates.

Ventilated Brush for Dyanmos, H. H. Cherry and S. D. Younglove, 480,769. Filed Oct. 2, 1891.

A ventilated brush consisting of a perforated core enclosed in a perforated wrapper and a clasp connected to the brush body.

Commutator for Ring Armatures, G. Pfannkuche, 480,780. Filed July 8, 1890.

Claim 1 follows:

A commutator having the sections provided with transverse recesses and arranged so that said recesses in adjacent sections overlap.

Galvanic and Thermo-Electric Batteries:—

Battery Cell, E. P. Usher, 480,881. Filed Feb. 19, 1892.

Employs a lining of acid-proof gum and a thin shell embedded in the gum and coated externally and internally therewith.

Electric Battery, P. Steins, 481,(75. Filed Apr. 20, 1892.

A system of filling and emptying battery cells from some one convenient point.

Lamps and Appurtenances:

Holder for Arc Lamps and Similar Globes, Frederick D'A. Gould, 480,720. Filed Dec. 5, 1891.

Electric Arc Lamp, F. D'A. Gould. Filed Dec. 5, 1891.

Employs tilting mechanism for forming the arc and feeding the carbon.

Electric Light Fixture, J. T. Robb, 480,745. Filed Aug. 31, 1891.

A hanging fixture having a universal joint at the socket so that the lamp will always hang vertically.

Standard, L. T. Stanley, 480,749 Filed May 15, 1891.

Combined Gas and Electric Light Fixture, A. T. Enos, 480,818. Filed Oct. 31, 1889.

Incandescent Electric Lamp, G. F. Melick, 480,954. Filed March 4, 1892.

Has several filaments connected in series and a short-circuiting switch mounted on a metal sleeve on the base of the lamp.

Electric Arc Lamp, R. Schefbauer, 480,968. Filed Nov. 24, 1891.

Employs a differential solenoid and suction core, a carbon carrying rod passing into said core and a magnetic friction device, one part of which is connected to the core and another part geared to the carbon carrying rod.

Adapter for Incandescent Lamp Sockets, H. P. Ball, 480,968. Filed May 7, 1892.

Consists of a sleeve having inwardly extending flange at its base and an insulating disc in the end of the sleeve having a central screw-threaded hole for the purpose of connecting with Edison or Thomson-Houston lamps with equal facility.

Incandescent Electric Lamp and Lamp Socket, B. Ford, 481,019. Filed Nov. 27, 1891.

Has for its object a construction in which the short-circuiting fusible plug is arranged in the lamp proper instead of the socket.

Incandescent Electric Light, E. McOnat, 461, 047. Filed July 9, 1891.

Has for its object to lessen the length of platinum wire required to mount the filaments.

Measurement :—

Electrical Measuring Instrument, E. Weston, 480,888. Filed March 11, 1891.

Claim 1 follows:

In an electrical measuring instrument a movable index arm and a body of diamagnetic material, in plain or disc form, disposed transversely the lines of a field of force aud connected to, and operating to retard or oppose the oscillatory motion of, said index.

Apparatus for Retarding or Dampening the Motion of Moving Bodies in Electrical Instruments, E. Weston, 480,889. Filed March 11, 1891.

Employs a coil mechanically connected and moving bodily in an axial direction in the field of force.

Electric Time Indicating Apparatus, E. Weston, 480,890. Filed June 4, 1891.

A loop conductor vibrating in a field of force on the passage of a current and a device for showing the number of its vibrations.

Temperature Regulating Device for Electrical Circuits, E. Weston, 480,891. Filed June 4, 1891.

Employs a coil formed of an electrical conductor, the resistance of which increases with augmented temperature, a conductor connected in series with said coil, the resistance of which decreases with augmented temperature, the latter conductor being so proportioned as to render the combined resistance of the two substantially constant.

Electrical Measuring Instrument, E. Weston, 480,894. Filed Jan. 8, 1892.

Relates to means for causing augmented deflections on the index of an electrical measuring instrument for equal increments of moving force thereto applied.

Electrical Measuring Instrument, E. Weston, 480,895. Filed Jan. 14, 1892

Employs a flexible body of conducting material in a main circuit, means of applying strain at an angle to said body and an index and scale showing the displacement of the body under strain.

Electrical Measuring Instrument, E. Weston, 480,896. Filed Jan. 14, 1892.

Similar to No. 480,895.

Electrical Measuring Instrument, E. Weston, 480,897. Filed Jan. 14, 1892.

Depends upon the principle that a wire when heated by a current passing through it will become elongated relatively to the current strength.

Electrical Measuring Instrument,, E. Weston, 480,898. Filed Feb. 17, 1892.

Claim 1 follows:

In an electrical measuring instrument an enclosing case, having a portion of one of its walls detachable, and a scale upon said portion.

Electrical Measuring Instrument, E. Weston, 480,899. Filed Feb. 19, 1892.

Employs a magnet having concentric poles and movable coils extending through the inner pole and through the space between the two poles.

Electrical Pressure Indicator, J. W. Howell, 480,947. Filed Jan. 2, 1892.

Employs a resistance sensitive to changes of current and having another resistance reserved as a test, and a switch adapted to throw either one in circuit as desired.

Metal-Working :—

Arc Welding and Heating Apparatus, P. I. Unwin and H. Howard, 480,794. Filed June 14, 1892.

Has for its object the economy of power when a number of circuits are being employed intermittently so that all, a few or none may be in use.

Method of Electric Welding, H. Howard, 481,080. Filed May 31, 1892.

Miscellaneous :—

Injector or Inspirator for the Larynx, etc., W. Scott, 480,787. Filed March 14, 1892.

Has a hollow handle holding a small battery furnishing current to a lamp at the extremity of the instrument.

Electric Dispatch System, A. Bryson, Jr., 480,804. Filed Oct. 15, 1891

Employs a motor, a carrier, a guide located at each of the branches of the track, means for allowing the sender to engage automatically with a predetermined guide and a continuous conductor for supplying current to the motor.

Electric Elevator, F. E. Herdman, 480,845. Filed Oct. 20, 1891.

Has for its object to regulate the speed of an elevator proportionately to the load.

Electric Elevator, F. E. Herdman, 480,846. Filed Dec. 22, 1891.

Similar in its object to 480,845.

Rheostat, E. Weston, 480,892. Filed Dec. 5, 1891.

Employs two suspended bodies of conducting material in juxtaposition and a means positively acting upon both to force them into more or less close contact.

Rheostat, E. Weston, 480,893. Filed Dec. 10, 1891.

Employs two series of contact plates opposite one another on the circumference of a circle, and resistances interposed between them.

Process for Recovering Tin from Tin-Plate, M. R. Garcia, 480,920. Filed Dec. 24, 1890.

An electrolytic process for separating the tin from the plate to which it adheres.

Joint for Electric Wires, W. E. Harrington, 481,025. Filed Aug. 28, 1890.

A sleeve joint for trolley wires, etc.

Railways and Appliances :—

Guide for Replacing Electric Trolleys, C. Fortin, 480,766. Filed April 11, 1892.

A bifurcated lever arm pivotally secured to the trolley pole and having its upwardly extending members inclined outwardly for the purpose of guiding the trolley wheel to the wire in case of displacement.

Electric Railway, R. M. Hunter, 480,850. Filed May 28, 1887.

Has for its object to provide means for supplying current from a surface conductor which shall be cut out of circuit except when the vehicle is passing over it.

Electric Locomotive, R. Eickemeyer, 480,918. Filed Dec. 21, 1859.

Employs a construction by which the motor is pendant from the truck frame and has its armature shaft substantially in the horizontal plane occupied by the axle.

Electric Control of Railway Trains, R. C. Sayer, 481,062. Filed March 10, 1892.

Has for its object to control the motion of the train automatically by electrical means, the power being led to the motor through a valve switch or other means as circumstances require.

Switches and Cut-Outs :—

Snap Switch, F. d'A. Gould, 480,722. Filed Mar. 26, 1892.

A snap switch in which the switch arm remains stationary in both its open and closed positions until a spring suddenly operates to close it.

Electric Fuse, O. T. Blathy, 480,802. Filed May 8, 1890.

Employs one or more dics threading the fuse wire for the purpose of absolutely preventing the formation of an arc after the wire has blown.

Adapter or Plug for Incandescent Lamp Circuits, E. Weston, 480,900. Filed Mar. 21. 1892.

Rosette for Electric Lighting, E. W. Buffinton, 480,915. Filed May 27, 1892.

Snap Switch, J. Hutchinson, 480,948 Filed Jan. 12, 1891.

Has a circular track with a series of double inclines and contact plates in the alternate depressions formed by said inclines, one end of each contact plate being in the form of a spring.

Telegraph :—

Combined Telegraph Key and Circuit Closer, W. F. Lott, 481,114. Filed April 26, 1892.

Telephones and Apparatus :—

Microphone, E. Noriega, 481,048. Filed June 11, 1891.

A carbon for microphones formed of charcoal, graphite, boric acid and water.

Telephone, E. Noriega, 481,049. Filed June 11, 1891.

Employs a pole-piece formed of a series of round rods of different diameters attached to the pole of a permanent magnet and forming a core to receive the bobbins.

Microphone, E. Noriega, 481,050. Filed May 7, 1892.

Employs a vibratory carbon plate, a fixed carbon plate and a mass of carbon filaments between the two.

Electric Annunciator, F. A. Pickernell, 481,120. Filed April 16, 1892.

A combined annunciator and reset for telephone systems.

Telephone, F. H. Brown, 481,138. Filed Mar. 23, 1891.

Employs a permanent magnet, one pole of which is movable in close proximity to the other pole, a diaphragm and a connection between the diaphragm and the movable pole of the magnet.

CARPENTER ENAMEL RHEOSTAT COMPANY.

THE CARPENTER ENAMEL RHEOSTAT COMPANY, now have their works at Bridgeport, Connecticut, in full operation. The extreme cheapness and evident advantages of this rheostat have been the cause of an unexpectedly large business, although the works have only been in operation a short time. Orders have already been received from over 50 different concerns, one order alone being for 1,000 rheostats.

The capital stock of the company is 100,000 fully paid. The officers of the company are H. Ward Leonard, president; Geo. H. Finn, vice-president; Charles E. Carpenter, secretary and treasurer. Several prominent and wealthy New York gentlemen are financially interested.

The manufacture of the rheostat involves a great many trade secrets, which, together with several strong patents and extremely low prices and a progressive business policy, seem likely to soon make the coiled wire rheostat a thing of the past. The company promises some startling developments in the patent situation at an early date.

THE WIGHTMAN ELECTRIC MANUFACTURING COMPANY.

THIS active concern, at Scranton, Pa., has enjoyed a busy summer and looks forward to a rushing fall trade in its railway motors and specialties. A number of improvements have lately been made in the motor, one of which is to shift the commutator to the side of the armature furthest from the gear. This is much better mechanically, and enables the motor to give an increased output for the same input. The casing to protect the motor has also been made more complete, yet the motor is much easier to get at and to repair, if necessary. The new type gives excellent results.

The company has recently undergone change in its management, and the following is now the list of officers: Oscar T. Crosby, president; R. E. Dunston, general manager; Merle J. Wightman, vice-president and electrician; H. E. Hand, secretary and treasurer. The new superintendent is Mr. T. V. Bolan, a useful importation from the Lynn factories. Mr. Bolan is a graduate of the Massachusetts Institute of Technology, and has paid considerable attention to railway motor work.

ANNUAL STATISTICS OF THE PATENT OFFICE.

THE annual report of W. E. Simonds, Commissioner of Patents, to the Secretary of the Interior, shows that during the fiscal year ended June 30, 1892, applications for patents and caveats were received as follows: Letters patent, 39,987; design patents, 983; reissue patents, 114; registration of trade marks, 1,919; registration of labels, 541; caveats, 2,401; total, 45,945.

There were during that period 23,626 patents granted, including reissues and designs, and 1,563 trade marks and six labels registered; 12,427 patents expired during the year. The receipts from all sources during the year were $1,268,727; expenditures, $1,114,134; leaving a surplus for the year of $154,593. Since its establishment the Patent Office has turned into the Treasury $4,102,441 above its expenditures.

The number of applications awaiting action on the part of the office on June 30th was 9,447.

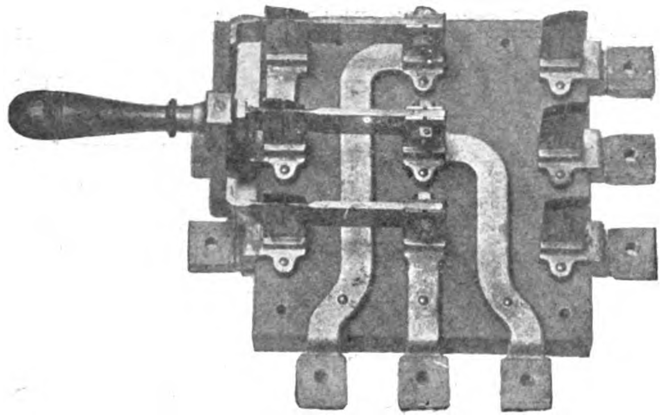
TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

Are you in business for pride, pleasure and profit? Then advertise.

THE GENERAL ELECTRIC CHANGEOVER SWITCH.

To meet a demand created by the increasing adoption of electricity for lighting purposes, the switch shown in the accompanying illustration has been devised by the General Electric Company. This is constructed for use as a main switch on installations, provided with independent or isolated dynamos, and at the same time connected with the street service. The switch is mounted upon a slate base. Three connecting wires are arranged crosswise between the two sets of side contact clips. To these bars are hinged three switch blades having a common handle, which can be thrown into either set of contact clips. Two of the clips on one side are connected, and it is on this side that connection is made with the main wires of the isolated plant, which must be wired according to the three wire system. It is necessary that the neutral wire which is brought to the central connecting bar of the switch should be of larger sectional area than usual. When the lights are being run from their own isolated plant the neutral wire acts as the positive conductor, the two outside wires serving as the negative. Thus, when the isolated plant is shut down and the street service thrown on, the building is lighted on a true three-wire system.



General Electric Changeover Switch.

The advantageous uses to which this switch can be put are numerous. In factories having isolated electric plants, the operation of the boilers, engines and dynamos after whistle-blow, when part of the force is working overtime would be extremely costly. Connection with the street service is therefore made, the switch illustrated thrown over from the isolated service, and the factory lighted on an economical basis. The switch can also be used as an emergency or break-down switch in case of injury to the isolated plant. In theatres and other public institutions, where a sudden extinction of light would be apt to cause a panic, it is a moment's work only to switch on the current from the street and avert disaster.

CENTRAL ELECTRIC CO.

The Central Electric Company report that the ten-story Lakota Building in Chicago is to be wired throughout with Okonite. Interior Conduit will also be used. They also report having secured an order for some ten miles of No. 6 Acme lead covered cable, tested for 5,000-volt circuit. The company's sales for Gladiator dry batteries have been so large for the past few weeks that their stock is completely exhausted. They are, however, receiving a large consignment, and will be in a position to again fill their orders promptly.

President W. H. McKinlock has been cruising on the Southern Massachusetts coast, and reports delightful weather and excellent fishing. He has been touching the principal watering places and has been having a thoroughly enjoyable time. His brother, Dr. John McKinlock, of the Central Electric Company, has been spending a few weeks with his family at Mackinac Island, and no doubt will return with renewed vigor for the winter's campaign.

Mr. Romaine Mace, the representative of the Interior Conduit & Insulation Company, has been spending a few days with the Central Electric Company, consulting with them regarding the best methods to pursue in pushing the sales of the Interior Conduit Company's specialties, and taking care of the large business which they are securing. The Central Electric Company report flattering prospects for a heavy trade the coming fall on these now essential devices.

THE "TWIN CONDUCTOR" AND HOTEL OVERCHARGES.

The following letter to Mr. E. W. Little, general manager of the Interior Conduit & Insulation Co., gives striking proof of the merits of the twin conductor and the brass conduit tubes:

Philadelphia, Pa., Aug. 12, 1892.

Mr. E. W. Little, General Manager,
42 Broad street, New York.

Dear Sir:—Thinking it would be of interest to you to have a testimonial relating to the performance of your standard twin conductor at the New Neversink Mountain Hotel, Reading, Pa., during the recent and very severe electrical storm, I being an eye witness, and Walker & Kepler the contractors, it was very gratifying to see the results; we have tubed the entire hotel with about 30,000 feet of the brass conduit tube, and have placed the twin wire throughout the entire building.

The lightning was said to be the most severe ever seen in Reading even by the oldest inhabitants of that place, and seen to play around and through the building in every direction, but did not affect our lines in any manner, not even so much as to blow the smallest fuses.

During the storm several of the lamps were broken by the overcharged lines, the glass being blackened as though they had been painted with black paint on the inside.

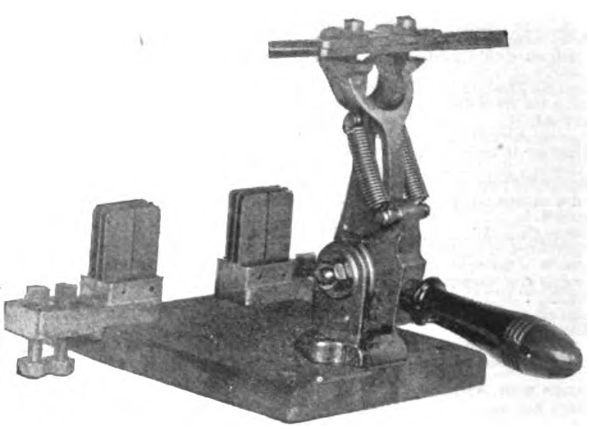
Some were burst, and cracked like little pistols when they went off. The building gets its current from the Reading Electric Light Co., whose plant is located 9,500 feet from the hotel. It is an overhead system, and therefore the overcharge in such a storm would be very heavy.

Hoping that this testimonial will be of some benefit to you, I remain,

Yours respectfully,
(Signed) I. C. Walker.

THE CROSS-BAR INSTANTANEOUS SWITCH.

The "Cross-Bar" instantaneous switch, shown in the accompanying illustration, is the invention of the General Electric Company, and is the latest high voltage instantaneous switch to appear upon the market. As its name indicates, it is a switch having its contact blade at right angles to the actuating lever. The terminal clips are placed opposite to each other, but widely separated, and the circuit closes as soon as the cross-bar simultaneously enters both clips. This cross-bar is loosely supported in the pawl of the lever by two steel pins, and a small steel spring serves to press the bar against the lever so that it will enter the clips truly, and make full and easy contact with both inside faces. Practical use has shown that this flexible method of mounting the cross-bar increases the durability of the switch, the alignment of the parts being rendered less liable to destruction by violent or careless handling. The snap, or instantaneous, action is obtained by means of two strong helical springs, which are attached both to the handle and the lever. The downward movement of the handle distends the springs to that point of tension which compels the obedience of the lever, and the cross-bar flies out from the clips, breaking the circuit at two points and reducing the possibility of arcing to a minimum. When the switch is fully opened, a catch-spring retains it in position, and an accidental closing of the circuit is rendered impossible; this small spring also serves to give a snap action to the switch when the circuit is made.



Cross-Bar Instantaneous Switch.

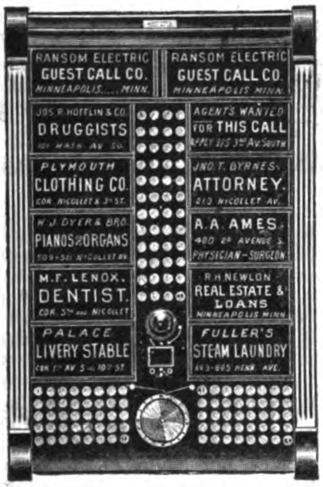
The principal novel points claimed for this switch are: Considerable distance between the clips; an absolutely instantaneous breaking of the circuit and a perfect flexible and frictional contact. The smaller sizes have the cross-bar in a single piece, while those of larger capacity are provided with a double parallel bar as shown in the engraving.

THE ELECTRIC GUEST CALL.

The accompanying illustration shows a new hotel annunciator, introduced by the Electric Guest Call Company, of Minneapolis, Minn., the operation of which will be readily understood.

The electrial dial has 48 pins in the edge of the rim corresponding to the quarter hours. The operation is as follows: "A," room 18, informs the clerk that he wishes to be called at 7.30 a. m., the check hanging on hook 18 is hung on the 7.30 hook above and the pin in the dial marked 7.30 pushed in. "B," room 22, is to be called at 8 a. m.; No. 22 check is hung on 8 o'clock hook above and 8 o'clock pin pushed in. "C" also wants to be called at 7.30, his check is also hung on the 7.30 o'clock hook; the pin on the dial having been pushed in for "A" need not be touched. It will be seen at a glance that no guest should be missed as all of the rooms to be called at a given time hang on the same hook and one ring answers for all. No further attention need be paid to the matter until the electric bell rings, which will be at the different hours it may be set for. The bell will ring several minutes or can be stopped at once. The wires do not run to the rooms in the hotel as the guest call is complete in itself. The clock is a good Seth Thomas time-piece.

The whole device is very simple in action and cannot readily get out of order. In an instant the dial can be set to ring each 15 minutes during the night and can be used during the entire day to remind the clerk of wants at specified times, etc. The bell is on the outside of the case, which is 26 inches wide, 8 inches deep and 40 inches high, and can be hung against the wall. It is sent ready to hang up and does not need an expert, but can be set up by any one. The two top signs measure 5 x 11 inches and the 10 side ones 5 x 9 inches and are tastefully executed, the whole making an ornamental as well as extremely useful device.



Electric Guest Call.

THE CARDEW VOLTMETER FOR ALTERNATING CURRENTS.

The Cardew Voltmeter is recognized as a standard switchboard instrument for alternating currents, while an essential feature is its equal correctness when used on continuous circuits. Queen & Co., of Philadelphia, who own the American patents, are making these voltmeters in quantities to supply the demand, and have also reduced the prices considerably, which announcement is of importance to intending purchasers. The merits of the Cardew instruments are fully set forth in price list No. 290, which can be obtained from the makers for the asking.

AN IMPORTANT ELECTRIC RAILWAY PLANT IN NEW YORK STATE.

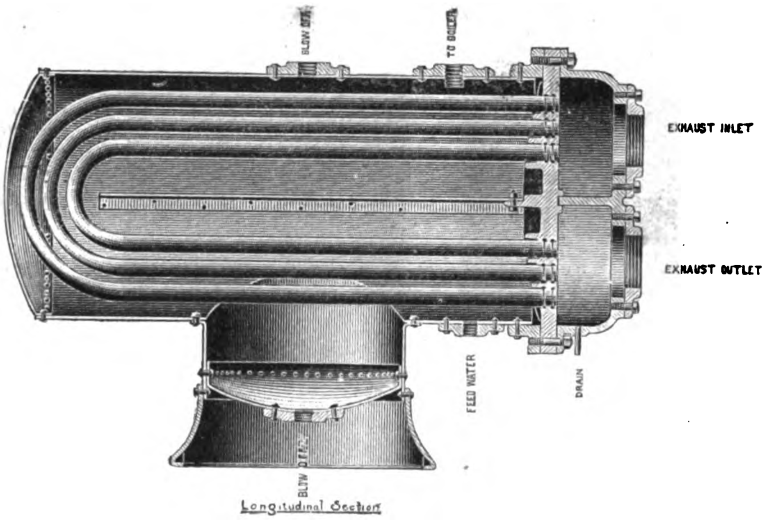
Perhaps the most important and novel electric railway work recently undertaken is that of the Cayadutta Electric Railway, connecting Fonda, Johnstown and Gloversville, N. Y. It will parallel a steam road, and electric locomotives will for the first time be in direct competition with steam locomotives for freight as well as passengers. The complete construction has been undertaken by H. Ward Leonard & Company, including grading, roadbed, building, steam plant, electric generators, electric overhead work, cars, etc. The road will be in operation about December 1. This important contract forcibly illustrates the desire on the part of owners to deal with one contractor for the entire work, and especially with a contractor who is entirely independent of so-called "systems," and hence able to procure for such a plant the best and most recent developments in this rapidly changing industry.

STILWELL'S CLOSE HEATER—ITS SUPERIOR POINTS.

For more than a quarter of a century the Stilwell & Bierce Mfg. Co., of Dayton, Ohio, have made a specialty of manufacturing devices for heating and purifying the feed-water for steam boilers. Their latest contribution to that branch of industry is the Stilwell patent close heater, herewith illustrated, for which the following points of superiority are claimed: The heating tubes are seamless brass, U shape, and so fastened into the tube-sheet as to be absolutely tight. The base on which the heater stands serves also as a mud-well or settling chamber for the deposit of impurities, which can be readily blown off. Deposits of impurities in this settling chamber do not diminish the power of the heater. The cold feed-water enters the heater near to the steam-exit end of the tubes, thus offering the most favorable conditions for extracting the most heat from the exhaust steam.

The diaphragm which separates the shell into two equal sections, compels the feed-water to traverse the entire length of the heating tubes, and its exit from the heater is made at a point in close proximity to the incoming exhaust steam, thus insuring the highest possible temperature of the feed-water. The construction of the heater admits of its being taken apart, if necessary, for cleaning. The tubes and tube-sheet can be readily removed from the shell for that purpose.

Those interested can obtain further particulars by addressing the manufacturers as above.



Stilwell's Close Heater.

THE TICHENOR BATTERY AT YORK, PA.

It may interest some people to know that "Prof." A. C. Tichenor, of primary battery fame, has opened up once more, this time at York, Pa., where he is delighting and dazzling the natives with a fine exhibit "Over Free's Liquor Store." The juxtaposition between the store and exhibit may, perhaps, account for the eloquence of the descriptive article appearing in the *York Daily*, which devotes a column to the subject of "Prof." Tichenor's great inventions.

THE ENTERPRISE ELECTRIC CO.

An announcement that will be of great interest to the electrical trade in general is that made by the Enterprise Electric Co., of Chicago, of which Mr. W. C. McKinlock is president and treasurer, to the effect that they have secured the general Western agency for a special rubber wire manufactured by the National India Rubber Co., of Bristol, R. I. Futher details will be awaited with a good deal of interest and curiosity.

The Columbia Phonograph Company have prepared a number of cylinders of campaign songs with piano accompaniment, which they are ready to furnish in any quantity and for which they anticipate a ready sale.

INTERESTING RESULTS WITH FUSE WIRES.

THE accompanying cuts of fuse strips, made from two different alloys, show, in an interesting way, the difference in the manner

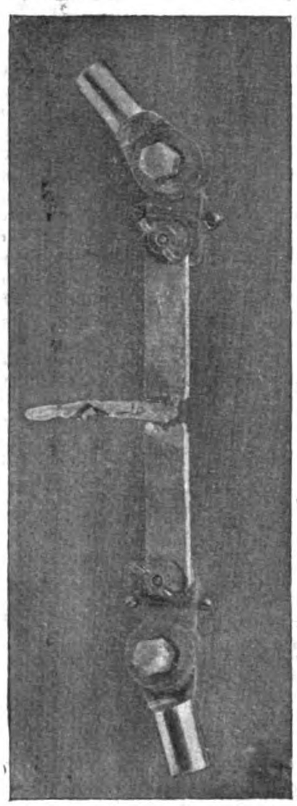


FIG. 1.

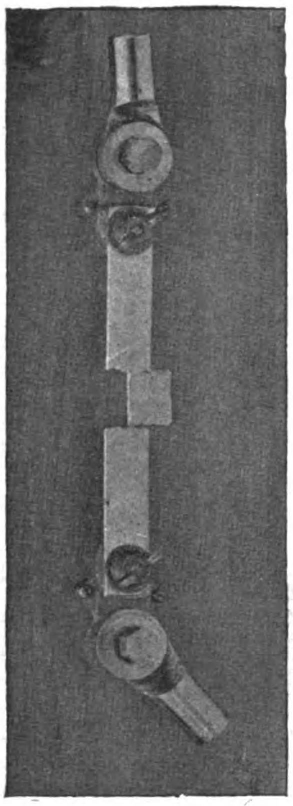


FIG. 2.

of fusing. Fig. 1 shows a strip made from the metal in common use. Under the action of the heat a crust of oxide apparently forms on the surface, preventing the fuse from breaking at once, but causing it to run and bubble in the interior until the molten metal breaks through this outer skin. It will readily be seen that such a fuse will open the circuit awkwardly—scattering the hot metal and causing much arcing. Fig. 2 shows a strip made from the special alloy used by the Shawmut Fuse Wire Co. in their tested fuse wire. In this the fuse remains solid until a certain point is reached, when, as will be seen, a part of the metal drops out bodily, making a quick and clean break of the circuit and thus preventing, to a large extent, the destructive effects on terminals and fuse blocks.

PROSPERITY OF THE FIELD ENGINEERING COMPANY.

THE FIELD ENGINEERING COMPANY report that they have had the contracts for all the railway work in Philadelphia for the last six months They helped all through the controversy last spring in obtaining franchises, etc., having charge of the expert part of the matter. They have had franchise for a year and a half for going ahead with all the roads in West Philadelphia, though the controversy which came up last spring in obtaining the franchise for the main part of the city delayed them in starting the work on these roads. The franchises were all obtained and work ready to go ahead with, except for the defect which developed on an application for an injunction. This has been denied on several of the lines, and they are now going ahead with this work in the main part of the city, and expect to have cars running before frost. This fall and winter and next summer the obstacles will probably be removed, so that the main part of the roads can be gone ahead with. They will approximate 150 miles, which it is proposed to equip with the trolley system. All that money and engineering skill can do will be done to make the equipment in all respects the best that has been done in the country, and all feeder wires will be put under ground.

The power plant which is being erected at present is a small one, only about 1,500 h. p. for operating the lines which are being equipped at present. The first main power station will be eight or ten thousand horse power. Construction work is very active with the Field Engineering Company on all their other contracts as well. They have four or five contracts on hand at Buffalo, including the main contract with the Buffalo Railway Co. They have already in operation there about sixty miles of road, the last part being started up a few weeks ago, and have 2,500 h. p. in the power station. The balance of this equipment, up to 5,500 h. p., and 250 cars, will probably be finished this winter.

The Newark and South Orange road at Newark is being rapidly equipped for the new company that has recently purchased it. It is expected that this road will be in operation early in the fall. It is one of the best paying roads for its length in the country, and was purchased recently for a million and a half of dollars from Mr. Radell, who paid about sixty thousand for it eighteen years ago.

At Trenton part of the system is in operation with the Short single-reduction motors. There will be an additional line started very shortly.

TOLEDO, OHIO, NOTES.

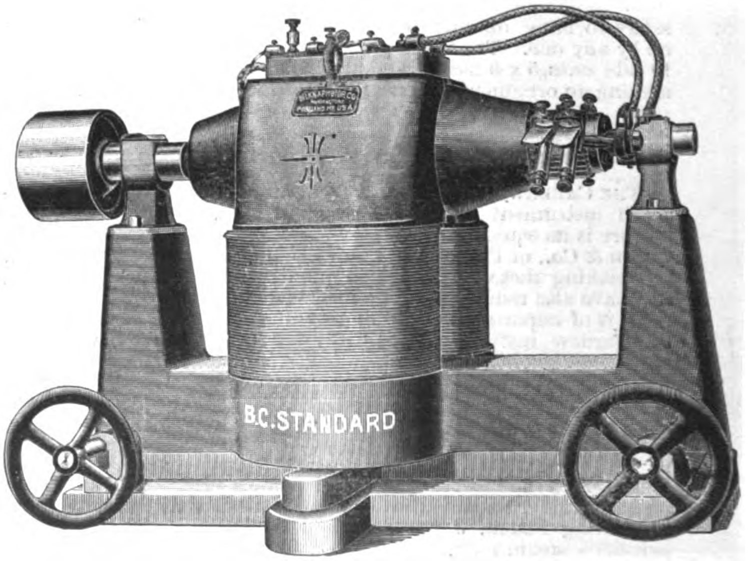
THE CONSOLIDATED STREET RAILWAY CO., of Toledo, Ohio, are equipping all their lines with electricity. Four large new T.-H. generators have just been added in the station. The new Belt Line is now completed and proving very popular. The company have had a number of banners made to put on cars which are being chartered every pleasant evening by parties who enjoy a whirl around the city.

THE TOLEDO ELECTRIC LIGHT STATION was destroyed by fire on July 30, with a loss of $75,000, insured for $61,500. New dynamos have already been ordered, and are being put in. Power will be furnished by the street railways and other companies until the new station can be built and equipped. The new plant will cost about $150,000.

THE TOLEDO ELECTRIC STREET RAILWAY CO. have recently made an excursion line of the Asylum line, running open cars through from Manhattan to the Asylum, every afternoon and evening and all day Sundays. The distance is eight miles, and it is one of the most interesting and attractive rides in the city.

THE B. C. STANDARD ELECTRIC MOTOR AND DYNAMO.

WE illustrate in the accompanying engraving the most recent form of the B. C. Standard electric motor and dynamo, manufactured by the Belknap Motor Co., of Portland, Me., who are also large manufacturers of water motors for various purposes. The B. C. dynamo or motor is compound wound, and therefore self-regulating, the field magnets being of the horseshoe type, the bed plate forming the yoke of the magnet. The wire of the field is wound on separate spools made of brass with leatheroid heads, which can easily be replaced. The armature is laminated, the sheets being all keyed to the shaft by one spline, and pressed firmly together by a nut at one end. The depth of the winding on the armature is very small, and this, together with the large quantity of iron in the field magnets produces a magnet circuit of low resistance and consequently a high inductive capacity for every foot of wire on the armature. The commutators are made of pure tempered copper, and spring brush holders are used, so made that the friction on the commutator is reduced to a minimum.



B. C. STANDARD ELECTRIC MOTOR AND DYNAMO.

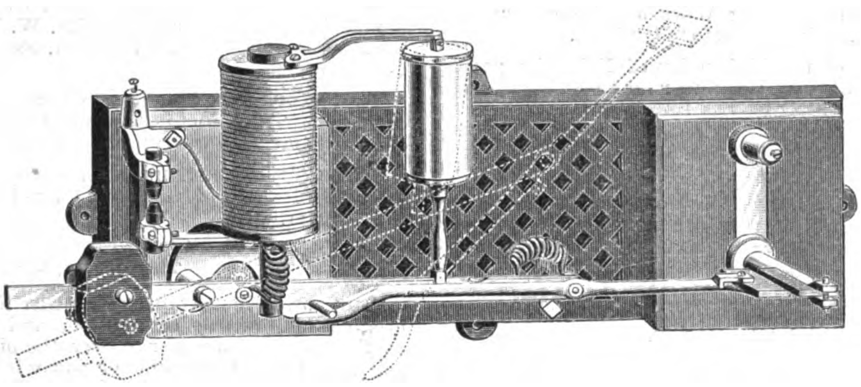
BOILER PITTING CURED BY GRAPHITE AND OIL.

In the *American Machinist* of July 28, Mr. T. T. Parker has a very interesting column article regarding pitting in boilers. Besides some clever theories, he has this to say from a practical point of view: "A boiler of the porcupine persuasion, pitting was found in the mud drum. Acting under advice, the drum was cleaned and scraped, after which it was painted with graphite mixed with cylinder oil. Measurements of the depths of the pits were taken, and six months after they were found no deeper, and no new ones had shown up. Other parties have since tried this experiment in mud drums, but it is too early as yet to give the result. However, knowing the character of plumbago, if the interior of a boiler could be painted with it in such a way that it would stay it may be this would prove a remedy. I am satisfied also that the person doing so would kill two birds with one stone, as the scale could be easily detached. In a pair of cylindrical boilers 42x28, occasional applications of cylinder oil (mineral) and plumbago have kept back corrosion on a trial of six months. Boilers were new when plumbago was used. The boilers which the new ones replaced were thrown out rotten from corrosion. The feed was mine water, as nothing else could be had."

To Mr. Parker's remarks, we may add that Messrs. Harig, Koop & Co., Louisville, Ky., after experimenting more or less trouble from rust and scale in the mud drums of their boilers, applied with great success graphited oil, purchased from the Joseph Dixon Crucible Company, Jersey City. The mud drums were cleaned out and the graphited oil applied with swab, brush, or anything handy to the joints and parts where the water enters the drums. Every four or six weeks this process is repeated with the most gratifying results.

THE COLUMBIAN LIGHTNING ARRESTER.

A reliable lightning arrester that will always operate is of the utmost importance to central station men and others, and to meet the requirement, the Interstate Complete Electric Construction Co., of St. Louis, have lately brought out a new form shown in the accompanying illustration which combines many new features. Is exceedingly simple and has proved its reliability under all conditions of service. The arrester comprises a solenoidal magnet operated by the main current, which opens automatically the path to ground taken by the lightning in the event of the dynamo current tending to follow over. This magnet is provided with a special dash-pot which allows a rapid movement upward with a slow return. One pair of carbon points in addition to the carbons at the point of break, and in series with them, are provided in case of an abnormal discharge, thereby always protecting the solenoid. As a further precaution, a special break-arm lever is used, giving additional distance and rapidity to the break. This arrester has already been put out in large numbers and under the most severe tests has never failed to operate; and its extreme simplicity, there being nothing to get out of order, recommends it at once.



Columbian Lightning Arrester.

The Collins Park and Belt Railroad Co., of Atlanta, Ga., is now in successful operation with two 150 h. p. generators and ten Brill cars, equipped with 20 h. p. single-reduction motors, all of which apparatus was furnished by the Short Electric Railway Company, of Cleveland, Ohio. The company are operating the two ends of their system, not having as yet been able to complete the line through a part of the city. The road has had unusual success from the start, and both ends are very much more than paying expenses. It is thought that it will be but a few weeks before passengers can be carried from one extreme of the city to the other.

WESTERN NOTES.

The Pabst Brewing Co., of Milwaukee, Wis., have placed their order with the Siemens & Halske Electric Co., of America, for their new 1,000-light incandescent central station. This installation will consist at first of two 250 h. p. dynamos, and one 90 h. p. dynamo. These machines will be of the well-known Siemens & Halske direct coupled type, the armature being placed on the end of the shaft. The Lake Erie Engineering Works have the order for the engines. The ultimate capacity of this plant will be in the neighborhood of 40,000 lights, and by means of the Siemens & Halske generators and Lake Erie engines, the space occupied will be very small. The electrical work is being done under the supervision of Mr. Geo. W. Gibbs, M. E., and the steam engineering under the supervision of the Osborn Engineering Company.

Messrs. Reed & Gross are exhibiting a cycloramic scene upon a magnificent scale of the Chicago fire of '71. The effects obtained by a large number of incandescent lamps, used to illuminate the scene, are exceedingly striking, and the work is highly truthful and realistic. Two large sized Crocker-Wheeler fan motors of the gyratory pattern which distribute the breeze from all points of the compass in turn, are used by these enterprising gentlemen to temper the warm evenings when the lake breeze is lacking. The Cyclorama, which is located at No. 129-131 Michigan avenue, is well worth a visit.

Clark & Marshall, of the Rookery, are to be congratulated on having secured the exclusive agency for the "Cope Automatic Come Along" and other specialties manufactured by T. J. Cope, of Philadelphia. They have also secured the agency for the "Arnold Flexible Bracket" for the states of Illinois, Wisconsin, Minnesota, Iowa, Missouri and Indiana. This bracket is manufactured by the Arnold Novelty Co., of Tacoma, Wash. They will have these goods on the market about September 1st. These goods can be seen at their office, and the trade is invited to call and examine same.

The New Athletic Building.—A recent visit to the new Athletic Building, on Michigan Avenue, gave us an opportunity to thoroughly examine the excellent work which Mr. L. K. Comstock, the electrical engineer, whose office is in the Monadnock Building, has recently done in connection with the wiring of the building, and the use throughout of Interior Conduit tube. Mr. Mace, the expert of the Interior Conduit and Insulation Company, on examining it, stated that it was as perfect and complete a piece of work as he had ever seen, and reflects great credit upon Mr. Comstock's able corps of assistants. The conduit for this building was furnished by the Central Electric Company.

The Electric Appliance Company are doing a splendid business on Packard lamps since the extension of their territory, and although it is still early in the season for lamp business, the outlook is certainly encouraging for an immense business during the coming fall and winter. The sales of the Paranite wire are also increasing daily and splendid results are being secured in every direction.

Mr. J. R Burdick, the traveling agent for the electrical and steam railroad department of the H. W. Johns Mfg. Co., was in Chicago last week having returned from an extended Western trip. Mr. Burdick reports business as excellent, and the sales in molded mica insulation as exceedingly large. Mr. Burdick favored the Western office of the Engineer with a call.

In the article by Mr. Fred. A. Scheffler on "The New Electric Cranes at the Brush Electric Co's. Works," which appeared in our issue of July 20, the author omitted to state that these cranes were manufactured by the Morgan Engineering Co., of Alliance, Ohio. This refers both to the traveling crane in the erecting shop and to the 15-ton pillar crane in the yard.

Mr. F. A. Pamperin, of "Brilliant" lamp fame, was a Chicago visitor last week. He spent several days in the interest of the Electric Mfg. Co., of Oconto, Wis., of which concern he is the general manager. The Chicago office of the company is located at No. 239 La Salle street; Wm. Hood & Co., managers.

Mr. A. A. Forman, manager of the Iron Mountain Electric Light and Power Co., Iron Mountain, Mich., spent a few days in Chicago during the past week.

TO LIGHT THE METROPOLITAN MUSEUM OF ART.

The New York Park Commissioners will on September 7, open bids for furnishing an electric plant and wiring and lighting the north wing of the Museum of Art. They will at the same time open bids for the construction of a boiler house for the use of this museum.

NEW YORK NOTES.

Among the contracts closed by H. Ward Leonard & Co., as bulk electrical contractors, during the past thirty days are the following:

Port Richmond Prohibition Park Railway, Port Richmond, S. I.; J. S. Kennedy's residence, Bar Harbor, Me.; New Netherlands Hotel, New York, City; Racquet and Tennis Club, New York City; Delaware, Lackawanna and Western Building, New York City; the Betz Building, Philadelphia, Pa.; the Havemeyer Building, New York City; the Continental Corset Company Building, Newark, N. J.; I. N. P. Stokes' residence, New York City; the Broadway Power House, New York City; the Cayadutta Electric Railway, Gloversville, N. Y.

The business secured by this concern during the past thirty days exceeds $400,000.

Mr. Ernest H. Heinrichs, who has charge of the Intelligence Department of the Westinghouse Electric and Mfg. Co., was in the city last week. He reports that the company is crowded with work entirely aside from its big World's Fair contract, and that it is now greatly increasing its factory facilities.

Prof. R. B. Owens, of the University of Nebraska, passed through New York on his way West to resume work after his summer vacation, during which he has been seeking coolness in the interiors of electric light stations. He has mapped out some very interesting work for the coming term.

The Engineering Equipment Company have become the sole Eastern representatives of the Railway Equipment Co., of Chicago. The Engineering Equipment Company are having an unusually good trade, and their orders on steel poles are behind in shipments at all times.

NEW ENGLAND NOTES.

C. S. Knowles, of Boston, have undoubtedly filled a want in their "Tenax" tape and splicing compound, judging by the large orders they constantly receive. A rubber tape, to be good, requires to be always sticky, and not easily dried up. The Tenax seems to possess this quality in a marked degree, and can be used at all times for making water-tight joints of high insulating capacity without the use of heat, a somewhat novel feature in such material. That the Tenax tape sticks may be easily proved by trying the experiment which is illustrated this week in our advertising columns. The following postal card which Mr. Knowles received a few days is amusing, as showing the curious places where electrical supplies may sometimes reach, and is at the same time convincing of the adhesive qualities of the compound. "Dear Sir: Your sample of Tenax splicing compound came duly to hand: I have used it upon a pneumatic tire and find there is no doubt about its holding."

Smith & Wallace, of No. 8 Oliver street, Boston, are announcing to their friends in the electrical trade that they have formed a copartnership under the above firm name, and are prepared to furnish all supplies needed in the equipping of electric railways. Mr. A. Otis Smith was for two years treasurer of the Eastern Electrical Supply Company, of Boston, and Mr. J. Edward Wallace was formerly connected with the same house as salesman, where he formed a wide connection with electric railway companies. Smith & Wallace will act as manufacturers' agents, or commission merchants, and their large connection among electrical men will undoubtedly enable them to do a large business.

Mr. F. A. Magee, who has been for the past year Eastern agent, in Boston, for the Underwood Manufacturing Company, of Tolland, Conn., has resigned his position with that company and returned to New York to accept a position with The E. S. Greeley & Company of that city. Mr. Magee is identified with the railway supply department and will handle a new line of electric railway material controlled by The E. S. Greeley & Company. Mr. Magee was formerly connected with this company, having been with them for over four years, and has a wide circle of friends in New York City, who will be glad to see him once more among them.

The Eddy Electric Manufacturing Company, of Windsor, Conn., through their Boston office, of which Mr. E. R. Gilbert is manager, report the following sales: A 400-light dynamo to H. H. McKay, Devonshire street, Boston, for use in the Old Provincial Gold Mines, in Nova Scotia; a 750-light dynamo to the Holtzer-Cabot Electric Company for Washington parties; a 80 h. p. motor and a 300-light dynamo for the new Lyceum Theatre on Washington street; and a 3,000 ampere generator for the American Lead Company, of Salem, Mass.

The C. & C. Electric Motor Company, of New York, through their Boston office, has been awarded by the city architect of Boston, the contract for the electric lighting plant of the city institutions on Long Island, in Boston Harbor.

Mr. W. H. Cole, electrical engineer, has just installed for the Colombian Government, an electric lighting plant for the city of Cartagena, Republic of Colombia, South America. American apparatus was used throughout.

PHILADELPHIA NOTES.

Queen & Co. have laid in a big stock of Deprez-Carpentier ammeters and voltmeters. These instruments are strictly dead beat, so that readings can be taken very quickly, and the scales are graduated from zero up. Being mounted in compact nickel-plated metal cases, they are adapted for portable testing as well as for switchboards. The prices are very moderate, and a considerable number have already been sold.

Mr. T J. Cope, of the Cope Pilot Line Co. has returned from a business trip West Mr. Cope gave exhibitions of their machine for running pilot line through conduits, and several large electric light companies in the West have adopted their use.

Mr. E. Ward Wilkins, of the Partrick & Carter Co., accompanied by his brother-in-law, Mr. W. W. Winship, are off on a sea trip on the yacht "Lizzie H. Partrick" under the care of Capt. John Meyers.

The Partrick & Carter Co. have a new automatic set back annunciator, a marvel in the line of annunciators, for which this company have a world-wide reputation.

The Commonwealth Co. are having a large run on small motors for fans, and have been obliged to refuse large orders during August.

TROY, N. Y., NOTES.

The power house of the Troy City Railroad on River street is progressing towards completion, and tracks are laid into the north house for cars to run over the pits for inspection and repair purposes. At present the power is received from the Division street power house of the T. & L. R. R., and so far has been amply sufficient to supply current for both roads. At Albia some changes in the car house have' been required, but these have had temporary attention only, owing to the unavoidable necessity for caring for the road-bed which has been almost entirely relaid and reballasted, since the changes involved by city improvements were inaugurated. That this has been done without serious delay is a matter of congratulation to the directory.

ST. LOUIS NOTES.

The St. Louis Electrical Supply Company will make a comprehensive, and elaborate exhibit of their specialties, among which they control many novel and valuable devices at the forthcoming St. Louis Annual Exhibition. A prominent feature of their display will be a number of electrical cooking and heating devices, and also a display of large Packard incandescent lamps for which they are agents, ranging from 200 to 500 c. p.

W. I. Brook reports the closing of a contract with the Burlington, Iowa, Electric Light and Power Company for one 22 x 48 improved Corliss engine built by the Sioux City Engine Works.

Days "**Kerite**" reports among recent sales an order from San Francisco, Cal., of four miles of seven conductor submarine cable; also another, one mile in length to cross the Mississippi at New Orleans. The factories of the Kerite Co. are rushed to the fullest capacity.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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RECENT IMPROVEMENTS IN TELEPHONE ENGINEERING.

BY

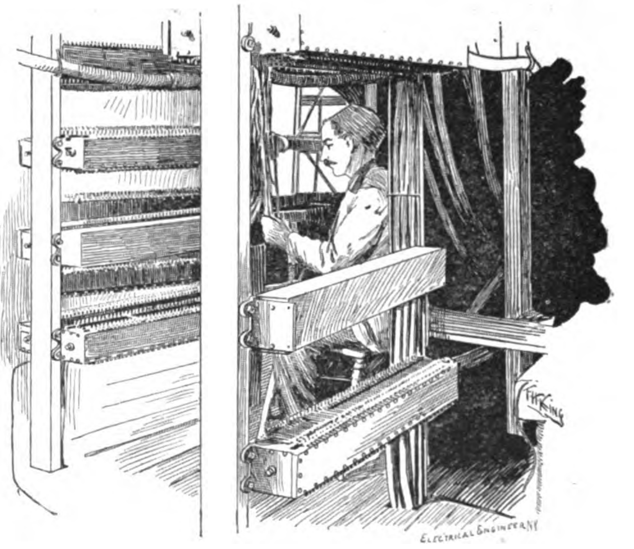
Herbert Laws Webb

GRADUALLY, steadily, and without stint of money, the telephone systems of large cities have undergone a remarkable process of reorganization and reconstruction during the last few years in answer to the demands for better service and for the abolition of overhead wires from city streets. Not very many years ago it was generally considered that "anything was good enough for telephone work," and badly constructed lines, poorly equipped central offices, and rusty, dirty, inefficient instruments were the rule rather than the exception. I remember once being told by a gentlemen who had done a good deal of telephone construction work, and done it very badly, that the insulation of a telephone line was quite immaterial and that he would guarantee good conversation over a bare wire laid along the ground! Such lax notions have quite disappeared now and instead of considering that anything is "good enough," most telephone men think that scarcely anything is too good for telephone work. The closest attention is now paid to details which before were almost entirely ignored, and any little point which may contribute to the efficiency of the system as a whole is most thoroughly investigated.

With the disappearance of the old networks of overhead wires and the crowded cupolas which formerly ornamented the top of telephone exchange buildings, and the introduction of underground cables, has come about the greatest change in telephone engineering proper. The adoption of the telephone cable brought with it a host of problems, both electrical and mechanical, and entirely disarranged the established order of things. Almost every portion of the telephonic system has been more or less upset, modified and changed by the underground cable.

When it became necessary to place the telephone wires underground very few people had had any experience with underground telephone wires. Where such wires had been used they were entirely unsuitable for systems that had to be planned out on a large scale, because they were both electrically and mechanically deficient and too expensive; therefore it was necessary to strike out in entirely new lines. When we have to strike out in entirely new lines we generally learn a good deal by experience in a comparatively short time, and with telephone cables this is particularly true; the experience gained in their manufacture and use during the past few years has been very valuable; and it certainly ought to be very valuable because it has assuredly cost a great deal.

The telephone cable of to-day generally contains one hundred separately insulated copper conductors, enclosed in a leaden pipe about two inches in diameter. Sometimes a larger number of conductors is used, one hundred and twenty, one hundred and sixty and even two hundred, but the hundred-wire cable is the standard type in most general use. The wires are twisted together in pairs, each pair forming a metallic circuit for a single line, therefore a hundred-conductor cable accommodates fifty subscribers. The insulating material used is generally cotton or paper, as india-rubber, gutta-percha, or any of the rubber compounds are debarred on account of their high inductive capacity—the greatest enemy to telephonic transmission. At first the insulating covering on the wires was impregnated with paraffine or some resinous compound to prevent too rapid absorption of moisture in case of rupture of the lead covering, but to reduce still further the inductive capacity the paraffin or compound filling has been abolished and the paper or cotton covering is left untreated. The telephone cable of to-day is more than fifty per cent. better, electrically, than that of two or three years ago. Its chief disadvantage, but one of course inseparable from the use of a non-waterproof insulating material, is that the insulation of the whole cable is dependent on the continuity of the lead covering. If the lead should be punctured or cracked so as to admit air, the covering of the wires will quickly absorb sufficient moisture to destroy the insulation and break down the whole cable. This risk seems more



A Corner in the Terminal Room.

important than it really is, because such accidents are quite infrequent; when they have occurred they have nearly always been traceable to some mechanical injury to the lead of a preventable nature. It may be argued that most of the cables in use are comparatively new and have yet to stand the test of time and long continued service; but then we know that lead is a most durable metal, if properly handled and safeguarded, and it is fair to assume that cables of this type ought to have a long life if they are carefully protected from external injury. So much for the telephone cable itself. Now let us see what changes it has brought about in the telephonic system generally.

For one thing it has had a certain moral influence which has made itself very distinctly felt. There is nothing very delicate about an overhead wire, and overhead construction in this country is generally carried out in a very slack manner. The wires are strung up anyhow and forever after left to their own devices, except when repairs are absolutely necessary, and then the last state of those wires is considerably worse than the first. Nobody ever thinks of testing an overhead wire, except perhaps some of the electric light companies, and these, when they do test their overhead circuits are particularly anxious to say as little as possible about the results. The general slackness of overhead construction is apt to spread to other parts of the work, and bad lines out of doors will be accompanied by poor inside wiring, joints and connections. With underground cables, however, things are quite different. They cost a good deal of money and are made to meet a rigid specification; their electrical conditions are carefully tested at first and watched afterwards to see that the insulation keeps up to, and the capacity below, the mark. The rest of the work naturally takes the key from this; refined methods and high standards must not be relaxed directly the terminals of the cable are passed; good insulation and careful work are required in the connecting wires, and gradually all the construction work is tuned up to concert pitch to be in harmony with the underground cable.

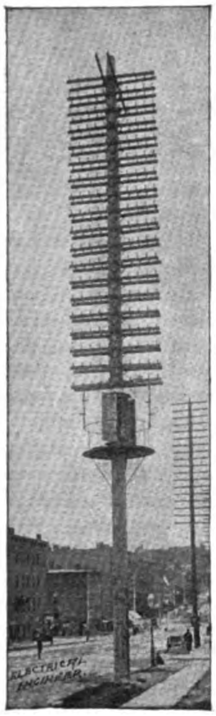
The actual changes in telephone engineering brought about by the extensive use of underground cables, are chiefly confined to the exchanges and terminal or distribution points; with the subways we need not concern ourselves here. It is readily apparent that the conditions under which the wires must be handled are entirely different where underground cables are concerned from what they were with overhead lines. The greatest difference is felt of course in the exchange, although it extends to the outside arrangements as well. With overhead wires each line is separate along the entire route, it is accessible at any point for repairs or alterations, can be led off in any direction required, and can be terminated wherever desirable or necessary. With underground cables, on the contrary, a large group of one hundred wires is inaccessible except at two fixed points, the terminals of the cable; from the outer terminal wires can be led off in different directions to subscribers' stations and with the inner terminal all the connections leading to the switching apparatus must be made. This inflexibility of the underground telephone cable makes it necessary to carefully calculate beforehand the best points for outside terminals in order to place them where a large group of subscribers shall be easily reached, so that each cable may be worked to the best of its capacity. In the New York down-town districts this difficulty is materially simplified by the large office buildings, many of which contain a sufficient number of subscribers to fill up one or more cables.

In the exchange building the problem of properly dealing with the large number of cables that naturally converges there has now been pretty thoroughly solved, both from a mechanical and electrical point of view. Probably the next few years will see still further changes and advances in the methods of handling underground cables at the exchanges, but the present system has been worked out very carefully and does not seem to be susceptible of much further modification, unless some startling improvements in the art should be introduced which would necessitate a complete revolution of existing methods.

The ends of the cables are enclosed in air-tight terminal heads of iron or hard rubber, provided with as many brass binding posts as there are conductors in the cable. The conductors are attached to these binding posts on the inside before the cover of the head is screwed on, and connecting wires can afterwards be attached to them on the outside whenever it is necessary to obtain connection with any conductor in the cable. The problem in the exchange is to lead in the cables in regular order so that any one of them can be traced out among the others, be accessible for repairs or alterations, and if necessary be drawn out and replaced by a new one; further, to arrange the terminal heads compactly so as to economize space, and in such position that the work of attaching the connecting wires, and detaching them whenever tests have to be made of the lines, may be easily done; further, to provide a systematic method of handling the immense mass of wires required in a large exchange to make the connections between the fixed terminals of the underground cables and the fixed terminals of the cables in the switchboard, so that every line shall be available for inspection at connecting points and readily traced out, and with provision for changing the connection between a given cable conductor and a given number in the switchboard at any moment; further, to provide efficient protection against lightning and other foreign currents at some point between the terminals of the underground cables and the switchboard apparatus. The problem, it is evident, is a formidable and a complex one, and it is interesting to see how the solution has been arrived at.

A fifty-pair telephone cable weighs about five pounds to the foot. A large exchange might need between one and two hundred of these cables to reach all the subscribers in its district, and it is readily apparent that to deal successfully with such a number of cables and cable heads and with such a weight of material, so as to economize space and secure all the conditions enumerated above is a task of electrical engineering by no means to be lightly attacked. It was at first thought that owing to the extreme weight of the cables, their inflexibility and liability to suffer damage if much handled, the best plan would be to terminate them at as short a distance from the subway vault as possible. The terminal room was therefore placed in the basement or cellar, and the cables were led in straight from the vault at the end of the subways under a false flooring and headed up in long rows, the terminal heads being attached in a vertical position to an iron framework. The connections with the switchboard on the top story were made by means of cables made up of large numbers of rubber insulated wires which ran up the building through a shaft or through ducts let into the walls. It was soon found that this system led to confusion. All changes in the connections between the switchboard wires and the underground cables are necessarily made in the terminal room, and also the tests on lines which are reported to be in "trouble." The operating department and the terminal room being so far apart, concentrated supervision of this important part of the work was impossible, and mistakes and delays were of frequent occurrence. Then, too, the frequent changes of connections among such a large mass of wires concentrated in a comparatively small space led to great confusion, involving much loss of time in testing out circuits.

This evil was attacked first, and the remedy was devised by Mr. A. S. Hibbard, general superintendent of the American Telephone and Telegraph Company. He constructed a cross-connecting or distributing board (everything to which a number of wires connect is called a "board" in telephone language, wehther it be made of wood or brass, hard rubber or iron) to form an intermediate link between the underground cable terminals and the terminals of the



Cable Tower on Terminal Pole.

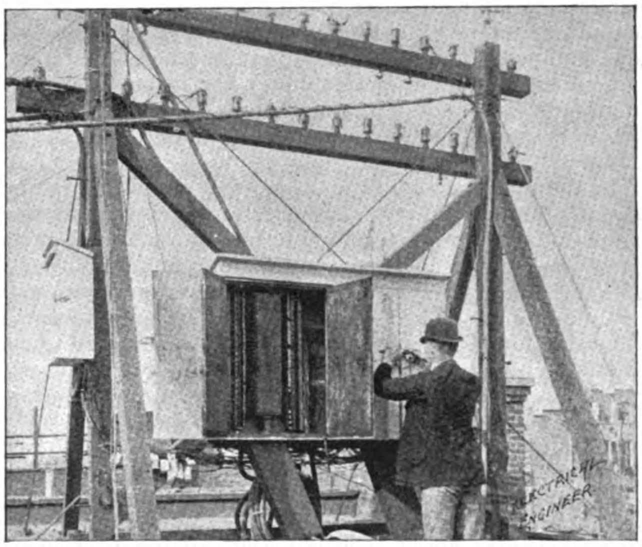
switchboard cables. This cross-connecting board is an iron framework or cage, made up of iron rods and tubing combined so as to form a number of vertical and horizontal grids. It is generally about three feet wide and eight or nine feet high, the length depending on the number of cables for which accommodation is required. On either side of the framework, at regular intervals, are fixed long strips of hard rubber carrying double rows of little metal ears or plates; to each of these ears two wires can be soldered. At one side wires leading from the underground cables are terminated, at the others the wires from the switchboard. This arrangement brings the wires of the underground system and those of the switchboard, all arranged in regular order, to fixed terminals within a few feet of each other. To connect them together all that is necessary is to solder a pair of wires to the metal ears on one side of the board, run them through the framework and solder them to the required ears on the other side. In this manner all risk of error in making connections is done away with, the switchboard wires on one side and the cable wires on the other all being numbered and connected in regular order, and there is no confused mass of loose wires to deal with. In a large telephone exchange many connections have to be made every day between the cables and the switchboard owing to the addition of new subscribers, changes of location among existing ones, and so on. The cross-connecting board reduces this work, which was formerly slow and uncertain, to a system which is at once both simple and expeditious.

When a new exchange is being equipped, as soon as the switchboard is in place cables are extended to one side of the distributing board and the wires are all connected up in numerical order. As the underground cables are put in, similar cables to those used for switchboard work are connected to their terminals and run to the distributing board, where they are all connected in place on the cable side of the board. The wires used for connecting across between the two terminal points are rubber insulated and twisted in pairs so that the anti-inductive arrangement of the underground and switchboard cables shall be maintained throughout the circuit. The wires follow definite courses through the framework, certain spaces being allotted to horizontal runs and certain others to vertical runs; the grid construction of the framework and the arrangement of the runs prevent large numbers of wires being massed together, so that it is easy to draw out any pair when it becomes necessary to change the connection between a pair of cable conductors and the switchboard. The distributing board has one other advantage besides those already named, which is that it allows of, in fact it demands, soldered connections at the points where the continuity of the circuit is broken; this is an important point electrically, as soldered connections are far safer than those afforded by any form of binding post.

ELECTRICAL ENGINEER.

Drawing in Telephone Cables.

The cross-connecting board having satisfactorily provided a method of making the connections between the cable terminals and switchboard, the next point which arose was the best situation of the terminal room in the telephone exchange. The work of making and inspecting the connections between the mass of wires in the operating department and the cable terminals involves numerous little details requiring careful and constant supervision, and ready communication between those in charge of the different branches of the system. Careful supervision and prompt communication were obviously best attainable by placing the operating department and the terminal room as near together as possible. The operating-room is placed always on the top floor to secure the best conditions of light, ventilation and freedom from the dust and noise of the street. These considerations precluding its removal to any other part of the building, the terminal room had to mount up from the basement to the top floor or to the floor immediatly below. The cables, then, instead of being terminated in a room immediately adjoining the subway vault had to be led up to the top of the building—no slight job when one considers the weight of the cables and the number necessary even in an exchange of only moderate size.



Underground Cable Terminal on Roof Fixture.

The very weight of the cable, however, has in some cases been a help rather than a hindrance, as the method has been adopted of taking the drums of cable to the top floor and paying out the cable down the shaft, a gang of men then taking charge of it and leading it through the basement to the subway vault. From one exchange in New York sections of cable five hundred feet long have been drawn from the drum in the terminal room through the shaft, basement and subway to the nearest street manhole half a block away.

The cables now, instead of being terminated in the basement, are supported there on a framework of iron bars mounted in stout wooden uprights; over the iron bars are placed wooden pulleys on which the cables rest and which prevent any injury to the lead covering during the operations of drawing in or out. The supports are placed close together to distribute the weight of the mass of cables and to prevent them from sagging, and they are so arranged that any cable is easily accessible for inspection or repairs, and can be drawn in or out without disturbing its neighbors. From the basement to the terminal room the cables follow a shaft built specially for the purpose. At first these shafts were threaded with iron pipes, in fact they were made like a vertical subway, a separate pipe being provided for each cable. An open shaft is now considered better, being cheaper and having the advantage that the cables are easily accessible at all points. The cables are attached by means of iron clamps to beams let into the sides of the shaft, clamps being placed at every floor, a door being provided at each floor to give access to the shaft. This method of supporting the cables is found to be entirely satisfactory; the strain is all in a vertical direction and is taken off by the clamp at about every eight or ten feet, therefore there is no chance for the cables to get out of place, nor for any heavy strain to be thrown upon one spot in a cable. At the top of the shaft, where the cables curve out to enter the terminal room, radial beams are placed intersecting the arc of the curve and the cables are clamped at close intervals to these beams. It is, of course, highly necessary to support the cables thoroughly at this point, as any strain thrown on the bend would probably result in buckling and cracking the lead covering.

In the terminal room the cable heads are arranged horizontally on upright iron frameworks. Placed horizontally a greater number of terminal heads can be arranged in a given space than if they are set vertically, and they are also more easily accessible for making connections, testing out lines, etc. Where possible, the framework carrying the cable heads is placed immediately opposite to the distributing board, making the connecting link as short as possible, and bringing all the operations of making connections and tests in one department. The work of making connections and tests is carried on by a staff of inside wiremen attached to the exchange and an inspector or wire chief, under whose directions the work is carried on. This official is provided with a desk equipped with a telephone set and instruments for making tests; wires run from the desk to various parts of the switchboard, and, by means of special lines, the instruments can be connected to a subscriber's circuit for the purpose of testing it out and discovering the location of any trouble that may be reported.

The provisions required for the distant terminals of the underground cables do not involve the engineering questions and careful design and calculation incident to the disposition of the cables and their terminals at the exchanges. It is comparatively seldom that more than one or two cables terminate at a given point. When possible, the terminals are placed in boxes in the basement of a building, insulated wires being run through the building to the rooms occupied by the different subscribers. Where subscribers are more scattered the cable is terminated on a roof fixture and connected by means of insulated bridle wires to the aerial lines attached to the insulators on the cross-arms above. On the terminal pole of an important overhead line, the wires of which have to be led underground from a certain point to the exchange, a cable tower is placed. This tower has enclosed protection capable of accommodating several cable heads, and a circular platform is fixed at a height of twenty or thirty feet above the ground so that the men can carry out the work of connecting up the cables in perfect security and comfort.

There are many other improvements in telephone engineering that are worthy of comment and description, but this article has already reached its limit and attained its object—a sketch of the changes brought about in telephone central office construction and equipment by the introduction of underground cables.

A FEW PRACTICAL OBSERVATIONS ON COVERED WIRE MAKING AND USING.

BY

Frederic A.C. Perrine

A GREAT deal has been said and written about "hay scales wire" and so few have been found to say a good word for this "weatherproof" wire of which most of our pole lines are constructed that the unfortunate superintendent whose company will not allow him to expend the money for a taped and braided rubber insulation feels ashamed of what he has done and answers under his breath "weatherproof" when asked his out-of-door insulation.

Are we really then so remiss in our regard for public safety in this country, and have we really no engineers brave enough to stand out for first-class construction in our central station installations? Across the water this opinion seems to prevail, and who can wonder when the men using such construction are so ready to acknowledge an inferiority in comparison with European work. In one case I know of, an American at a foreign exposition in charge of a telephone exhibit, which was surmounted by a great red cross-arm, green glass insulator, pole, etc., would tell all comers that it was intended as an illustration of our beautiful climate which would allow such *poor* construction. I do not think that such strictures on our engineering ability in this country are justifiable, or that the exceptions to our methods of construction are well taken. Rather it is one of those cases where the witless general average has drawn a better conclusion than the long-headed individual; or better it is a case in which a certain few well-informed engineers have taken the lead and been followed by the mass of constructors without the latter understanding the reason for their perfectly rational action.

I do not wish to be understood as advocating any work being done in an imperfect manner, nor do I wish to claim that weatherproof wire has as high an insulation resistance as a high grade rubber. But I do not consider that the *unattainable perfect* is engineering in its true sense; on the contrary I hold that the engineer should, with such means as are at his disposal, attain the best possible results as regards efficiency of plant, public safety and dividend payment by his company; and I do not consider that high insulation is the only consideration in all electrical installations.

Taking the latter point first, let us consider what are these wires which are called by the trade weatherproof, and taped and braided rubber, or as they have been nicknamed, "hay scales wire," and the "ites and shaws wire."

In the "ites and the shaws," our rubber manufacturers with the aid of the electricians have devoted their best energies, some to produce the most lasting insulation mechanically, some to produce the highest insulation resistance, and others to turn out the cheapest wire, and have used about every available compound of rubber and its substitutes. Except the last, of producing a cheap wire, these problems have been found to be very baffling, and although there are many different brands of rubber wire on the market, it is hardly possible to secure one which in the sun, the wind and the rain will maintain either its electrical or its mechanical qualities. A reason that this should be, may perhaps be known to that fortunate man who thoroughly understands the nature and cause of "blooming" in rubber goods. To be sure, this failure is not so complete that the insulation falls from the wire or that the galvanometer will show expensive leaks along the pole line, but it is serious enough to make the high insulation of a rubber wire line delusive, and to render contact with the wire possibly dangerous, if carrying high potentials in wet weather. While, as to the cheap shoddy rubbers which are sometimes used, and which make a very handsome wire to sell, as good and safe an insulation could be obtained by surrounding the wire with sponge.

Turning now to our "weatherproof wire," what is it? How should it be manufactured? And by what qualities is it suitable for pole lines?

A few years after the introduction of "underwriters'" wire, which was intended to fill the rules of the New York Board of Fire Underwriters for 1882, it was recognized that although an excellent insulation in dry buildings, it could not be relied upon in any way for out-of-door construction, and Mr. A. A. Knudson devised for Holmes, Booth & Haydens a compound having more waterproof qualities and intended to be applied to a braided wire as the underwriters had required. This compound of paraffine, cresine and asphaltum was a decided advance but was actually a long way behind the compounds used in the same manner and bearing the same names which are at present in use.

Almost every manufacturer has to-day a slightly different compound and different means of applying it, and not a few neglect the essential features of their product in order to obtain a handsome appearance and consequently easy sales to uninstructed purchasers. For the best results the insulating compound should be one which is applied to the wire after it has been rendered thoroughly liquid by heat, and which when so applied is not softened so much as to run when subjected in the open air to the warmth of the summer's sun, and which will not crack and open by swaying to the wind under the influence of frosts. The component parts should make with each other a true compound and not merely a mechanical mixture capable of being separated by the filtering action of the capillary fibres of the yarn. The yarn itself should be considered as a carrier and protector of the compound, and, for this reason, so proportioned as to be a minimum except in the outside braiding, where the strength is needed for protection against mechanical abrasion.

To manufacture such a wire as is described above is far more difficult than may be at first apparent, and the best results are often obtained in a product which has less the appearance of so doing than a more faulty wire. Perhaps the handsomest external appearance can be obtained by the application to a wire braided dry with a black dyed yarn of a well-made compound dissolved in bisulphide of carbon or coal tar naphtha; but although almost perfect in apperance, such a wire has almost all the undesirable elements. The yarn which has been applied to the wire in a dry state will always lie closely to its surface, and by its powerful capillary attraction will make a good contact communicating with the surface of the insulation from the conductor wherever the least moisture is absorbed; and the compound itself on delivering up its solvent maintains a slight porosity to aid in such an absorption, while the dye on the yarn fills the pores and renders it less capable of absorbing the heavy insulating compound, as well as offering little resistance to the absorption of water.

On the other hand if the wire is passed through a hot compound of very liquid and rather soft nature and immediately into the braiding machines where a single braid of a soft yarn is put on, and then again through the same insulation, and a couple of braids, one soft and open and the finishing braid close and hard, and is then again passed through a harder compound capable of being rubbed down into the crevices between the yarns, leaving a smooth surface for a finish, the essential features for a serviceable weatherproof wire are obtained.

With this method of manufacture it is impossible to make a wire which is perfectly uniform in every foot, or even for that matter, in every mile, so that the practice of selling by the foot which is perfectly satisfactory to both purchaser and manufacturer, in the case of a rubber covering is obviously unfair to both in this weatherproof, while the very cheapening of the product by increase of the insulation compound in proportion to the cotton yarn enhances the value of the covering as an insulation.

However perfectly manufactured, this wire is not and cannot be said to be insulated against a continued immersion in water, for the reason that no compound so saturates the fibres of a yarn as to altogether exclude a further absorption of water, and the only value of an immersion test is a comparative one of the rapidity with which the different grades will absorb water and fall to some arbitrarily determined low limit of insulation resistance. This being the case, weatherproof wire should not be used where it is not capable of continued inspection by the eye. For concealed work whether done between floors on cleats or porcelain insulators, or for wires imbedded in plaster, it is obviously unsuited, while even for tube work there is continually present a certain amount of risk, although these tubes if properly installed should be watertight and sealed, and its use under such conditions is not necessarily dangerous.

On a pole line, however, this wire is not only satisfactory, but for many reasons is the best possible, provided only it is chosen for care and correct principles in its manufacture, and not simply for the external appearance. The external surface of a hard yarn and polished compound is not only a protective against destruction through abrasion, but also leaves no projecting irregularities for the accumulation of rime and the lodgment of moisture. Internally the softness of the compound of itself repairs any minute cracks which may be made when stringing the wire in cold weather, and as time goes on it saturates more and more thoroughly the yarn which thus holds it in position, while its known nature will guard against the careless handling of live wires by the workmen; though accidental contact is not by any means attended with disastrous consequences.

It is in view of these qualities of weatherproof wire that it has been so universally adopted in this country, and by our best engineers. By allowing satisfactory construction at a moderate expenditure of capital, it has extended the privileges of the electric light universally throughout our country, while the more cautious but not more careful practice abroad has restricted the light to the largest and most wealthy centres of population.

THEORETICAL ELEMENTS OF ELECTRO-DYNAMIC MACHINERY[1]—XII.

BY

A. E. Kennelly

STRESS DISTRIBUTIONS—(*Continued.*)

As a consequence of the tendency exerted by an active conducting loop or coil, to move from a position of lesser to one of greater flux enclosure, the force urging it any instant along its path to its goal of maximum contents, will be the space rate of adding new flux at that moment to the flux already encircled. The coil will advance in such a such a manner that this rate of addition shall be the greatest rendered possible by the flux distribution, under the conditions imposed by the form of the coil and its geometrical freedom. The journey will thus be performed in the least time and by the shortest route that the system will permit.

We may observe this in the simplest case of two equal and coaxial circles of conducting wire maintained at radius distance, as represented in projection by Fig. 31. If unit current flows round circle A it will generate a M. M. F. of 4π which will force a total flux of, say, F C. G. S. lines through the circuit; or in other words, F will be the surface integral of flux through A. A certain share of F (in the case represented by the figure, numerically, $0.8958\, r$), will pass through circle D, and the total flux so intercepted—the surface integral of flux from *A* over *D*'s area—may be called *m*. This quantity *m* will be zero when the axial distance between the rings is infinite, will increase with their proximity, and in the ideal case of filamentary circles will numerically equal *F* when A and D coincide. Practically, the thickness of the wires forming the circles will limit their approach, so that *m* can never equal *F*. It is evident that when A's unit current is altered in strength to c_1 units, the M. M. F. will be altered in like proportion, changing both *F* and *m* to c_1 *F* and c_1 *m* respectively, but leaving the ratio $\frac{m}{F}$ of the total fluxes through D and A unchanged.

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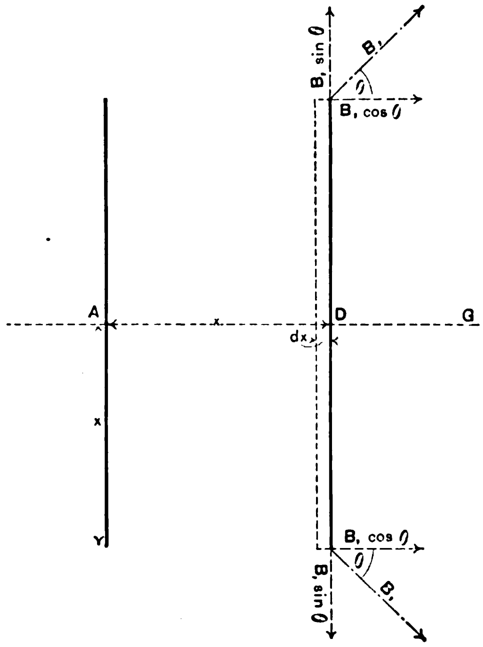


FIG. 31.

Round the circumference of circle D, the intensity due to the M. M. F. of c_1 will be, by symmetry, uniform in strength and in inclination θ with the axis A D, and its value may be denoted by B_1. As represented in the figure, this inclination will be almost exactly 45° or, $\frac{\pi}{4}$ in this instance, and equal to 1.61 $c_1 \div r$ C. G. S. lines per sq. cm. Resolved into components this becomes $B_1 \sin \theta$, in the plane of the circle, radially outwards in all directions from the axis, and $B_1 \cos \theta$ cutting the circumference parallel to the axis. In the case before us these components happen to be each 1.14 $c_1 \div r$, the current *c* being supposed to circulate positively, or counter-clockwise as viewed from G. The circle D is now filled with flux aggregating to c_1 *m* lines, terminated at the margin with these component intensities.

Next, suppose that a steady current of c_2 units is established in D, also counter-clockwise, as viewed from G. The stress distribution due to the combined flux systems will be represented by the vector product of $B_1 \sin \theta$ in the plane of D, upon c_2 round the circumference, urging D bodily towards A; also the corresponding vector product of $B \cos \theta$ on c_2 tending to expand the circle D radially, which force its rigidity will hold in check and which may therefore be dismissed from consideration. The summation of B_1 sin $c_2\ r\ d\ \theta$ round D is

$$P = 2\ \pi\ r\ B_1\ c_2 \sin \theta;\ \text{or}\ P = O\ B_1\ \ c_2 \sin \theta,$$

where *O* is the circumference of the circle, and *P* will be the force of attraction between them. If c_1 and c_2 circulate in opposite directions the same force *P* will be exerted in repulsion.

As a numerical illustration, applicable to Fig. 31, let the radius *r* and axial distance *x* between the circles be 5 cms.; $c_1 = 3$, or 30 amperes; $c_2 = 4$, or 40 amperes. B_1 then, becomes $1.64 \times \frac{3}{5} = 0.966$ at the circumference of D, and the local components $B_1 \sin \theta$ and $B_1 \cos \theta = 1.14 \times \frac{3}{5} = 0.684$ radially outward, and through the ring. The force of attraction between the circles will then be $P = 0.684 \times 2\ \pi \times 5 \times 4 = 85.96$ dynes.

This result can be expressed in terms of *m*; for if while c_1 and c_2 are flowing, the circle D is given a displacement *dx* along the axis, as shown, so small that B_1 does not appreciably alter within the range, *m* will increase by the motion and the total flux from A threading D will rise from $c_1\ m$ to $c_1\ m + 2\ \pi\ r\ dx\ B_1 \sin \theta$; for the surface integral of A's fluxes over D in its new position will, by the results of Part I, be equal to the surface integral over D in its previous position plus that over the cylinder *dx* generated by the circumference during the small displacement. This latter must be the intensity normal to the cylindric surface, namely, $B_1 \sin \theta$ into the area of that surface, or $O\ dx$, making $O B_1 \sin \theta\ dx$ in this instance numerically

$$1.14 \frac{c_1}{r} \cdot 2\ \pi\ r\ dx = 2.28\ \pi\ c_1\ dx,$$

and this will be the increase in D's share of A's flux for a small excursion *dx* of D. If this rate of increase were to continue unaltered for one centimetre of displacement, the increment would amount to $c_1\ B_1 \sin \theta\ O$ total lines, representing an increase in the value of *m* to the amount of $B_1 \sin \theta\ O$, and since $P = c_2\ B_1 \sin \theta\ O$ it follows that the attractive force between the circles is the product of the two current strengths and the rate at which *m* increases per cm. of advance, as gauged from a small displacement; or in symbols

$$P = c_1\ c_2\ \frac{dm}{dx}.$$

If *P* attains the negative sign in this formula, the pull will be exerted in the direction opposite to that of the infinitesimal displacement *dx*.

The share intercepted by A of flux due to unit current in D, must by symmetry be equal to D's interception of A's flux from unit current; that is to say *m* has *a* mutually reciprocal value between the circles. Again, if instead of being coaxial, A and D be removed to any distance and set at any inclination θ to each other, *m* will still be reciprocally equal. For, viewed from the centre of cirle A, D will be seen at distance *l*, say, and under inclination θ. On shifting the standpoint to the centre of D, A's distance and aspect must be relatively the same.

Further, we may remove the remaining limitations of equality and form, by proving that *m* will be mutual between any two circuits under any fixed geometrical conditions whatsoever. For in Fig. 32 let A, D, and F, be three equal squares fixed in space, D and F having one common side. If unit current flows round the contours of these squares, then the flux from A intercepted by F, say A_F must be equal by the above reasoning to the flux from F intercepted by A or F_A. Similarly $A_D = D_A$. Summing these two equalities, the flux in F and in D together, due to A, must be equal to that in A due to D and F coincidently, or $A_{D+F} = D_A + F_A$. The currents in the common side *k l* of D and F oppose and neutralize, so that *k l* may be removed without influencing this result. When this is done, the flux intercepted by A from unit current round *m k o p l n*,

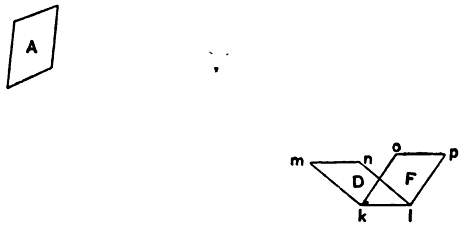


FIG. 32.

will be equal to the flux intercepted by $mkopln$ from that due to unit excitation in A. Continuing this process, any loops or series of loops can be constructed, having any sizes or shapes, and it will be evident that they have mutual and reciprocal values of *m*. This quantity *m* is called the mutual inductance of the two circuits. The proposition only holds good for non-magnetic media, and the introduction of iron into the system induces more or less deviation from the rule.

For a complex system of conducting loops, such as a pair of coils with many turns, situated in given relative positions, we might proceed to find *m* by establishing unit current in one coil, and then determining the flux due to this M. M. F. that is intercepted by each turn of the other coil, taken separately, and as though existing alone. Let m_1, m_2, m_3, ... m_n, be the separate interceptions of the *n* turns in the recipient coils, then the mutual inductance of the two coils will be the sum of these terms, or $\Sigma\, m$.

If an active coil made up of any arrangement of turns, be placed in a uniform prime flux due to an external M. M. F., it is clear that no motion of translation can alter *m*, although a rotatory dispacement will in general do so. The force tending to rotate the system coil round any axis will have a moment

$$t = c_1\, c_2 \frac{dm}{d\theta};$$

where $\frac{dm}{d\theta}$ is the rate of increase in the mutual inductance per radian or unit of angular displacement round this axis. The coil, if free, will rotate round that axis which possesses the greatest values of $\frac{dm}{d\theta}$ and *t*. If its freedom be restricted to motion round special axes or in certain planes, the coil will still select that axis of rotation left free which has the greatest value of *t*. The moving forces will vanish so soon as *m* attains a maximum, but frequently, the momentum acquired by the moving system in its rotation to this position will carry it beyond, against opposing forces, and set up an oscillation about the position of ultimate repose. This is the recognized general behavior of active coils and of magnets, their prototypes, when suspended in prime fluxes that are practically uniform.

When the prime flux is not uniform, a translatory motion will, in all but exceptional cases, increase the mutual inductance of the systems, and the moving forces will in general consist of a resultant force accompanied by a couple. The motion of the system will be that translation and rotation consistent with geometrical freedom, that will increase the mutual inductance most rapidly in space and time.

HYSTERESIS AND TEMPERATURE.

An abstract in the *Journal* of the London I. E. E. mentions some interesting experiments by W. Kunz on the effect of temperature on hysteresis. With equal maximum induction the hysteresis loss distinctly diminishes with increase of temperature. In a piece of soft iron the loss per cubic centimetre was 23,490 ergs when cold, 19,180 ergs at 530 degrees C. (dull red), and 21,640 when cold again. Steel showed a diminution of hysteresis of about 20 per cent. raised to 100 degrees.

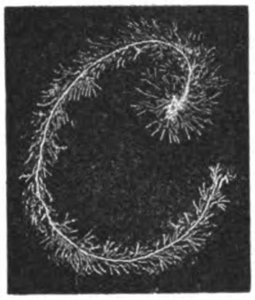
BERLIN ELECTRIC RAILWAY.

The proposal for the electric underground railway in Berlin is making progress. The line is to be equipped by the Allgemeine Company, and will be 30 miles long. There will be two generating stations connected together by mains, and using 500 volts. There will be 48 trains, each with three carriages, running at one time, the fare for any distance being 2½ cents. The trains will run on a three minutes' service.

DIRECTION OF ELECTRIC MOVEMENT.

BY

Philip Atkinson.



CURRENT is a word more freely used than understood. The instantaneous movement of electricity renders it impossible to determine by ordinary observation the direction in which it moves. A current will traverse a coil of wire hundreds of miles in length, with such rapidity that there is no appreciable difference of time between the closing of the circuit at one end and the click of the instrument at the other. A discharge of lightning is visible at the same instant throughout its entire length, which may be three to five miles, and the same is true of the spark discharge between the poles of a static machine, which is often six to eight inches in length. Any apparent movement of the lightning or the spark in a given direction rather than in the opposite is illusory; just as a horizontal discharge between two clouds may, from the effect of perspective, appear vertical, so that we imagine it to be from the cloud to the earth.

But we are not without evidence in regard to the direction of electric movement, and that evidence is in support of the theory that it is from a point where there is an accumulation of electric energy to a point where it is relatively less; so that the terms positive and negative, which represent these relative conditions, should not be regarded as mere conventionalisms, adopted for convenience, but as representatives of physical facts.

If a Töpler-Holtz machine be constructed with a wooden base, and a switch between the Leyden jars, by which the metallic electric connection between their outer coatings may be opened, the spark discharge is changed to a brush discharge; the passage of electric energy between the outer coatings taking place comparatively slowly through the insulating wood, and producing a corresponding slow discharge between the knobs of the discharging rods connected with the inner coatings. This brush discharge can be seen best in the dark, and is always far more prominent at the positive than at the negative pole. In the rapid spark discharge a single line of air becomes heated to incandescence for an instant only while it is traversed by the electric energy, but in this slow discharge the electrified air is continuously visible, so that the movement of electric energy which it represents can be studied; the electrified molecules repelling each other and producing the brush, that from the positive pole branching out into long forked red tongues, surrounded by a brush of whitish light, which passes over and becomes concentrated in a short brush of violet light on the negative pole, indicating in a very remarkable manner the movement of electric energy from positive to negative employing the air as its medium. This movement is indicated by the color of the discharge as well as its form; the change from bright red to violet showing decrease of energy in proportion to the work performed in overcoming the resistance of the air, just as variation of energy is shown by variation of brilliancy in the lighting of an incandescent lamp or the heating of an iron bar.

If the poles of a Töpler-Holtz machine be separated a little more than sparking distance, the discharge may be produced by bringing a conductor near enough to the negative pole to draw a short spark from it, thus reducing its electric energy and therefore increasing the potential difference between the poles. But if a spark be drawn in a similar manner from the positive pole, reducing its electric energy, the potential difference is proportionally equalized and no discharge produced, indicating that the positive and negative conditions are due respectively to an excess of energy in the positive and a corresponding lack of it in the negative, and that the discharge is a transfer of energy from positive to negative to restore the equilibrium.

Herewith is shown as an initial letter, an electric tracing of the letter C, reproduced from a photograph. I made the tracing with the knob of a charged Leyden jar on a plate of glass varnished with shellac, dusted sulphur on it, which adhered to the electrified lines, and removed the surplus sulphur by tapping the glass; the tracing is therefore a perfect reproduction of the work done by the electric charge. It was made just as one would make it with a pen, beginning at the dot of the C and moving the knob rapidly round to the opposite terminal of the curve, where it was lifted from the glass without stopping.

This tracing shows a broad fringe on both sides of the line traced by the knob, which consists of fine lines branching out from the main line with numerous subdivisions, all of which turn in the direction in which the knob was moved, while at the dot of the C, where the knob first touched the glass, they radiate from a common centre.

Assuming that the inner coating of the jar was positively charged, this shows that the electric energy moved from the higher potential of the main line to the lower potential on either side, radiating at first from the dot of the C, and that it was under the influence of two forces, one acting at right angles to the main line and the other parallel to it, by which it was turned forward diagonally in the direction in which the knob was moved. The electric energy acting inductively through the insulating shellac, produced a negative surface on each side, toward which it moved; but as the lines shot out at right angles, the inductive force from the knob, moving in advance of them, turned them forward diagonally.

If it be assumed that the inner coating of the jar was negatively charged, the movement of electric energy must have occurred in reverse order, but still from higher to lower potential as before; moving towards the dot of the C, and towards the negatively charged line and advancing knob from the adjacent surface charged positively by induction; so that this experiment shows only the relative direction of electric movement from positive to negative, and not its absolute direction. Its chief value lies in the fact that there is no movement of electrified matter, as in other experiments, which is liable to be mistaken for the transference of electric energy; the fringe being a permanent record left by the energy itself in the fixed shellac surface.

In the figure of the letter G shown by Lichtenberg, who was the first to observe this phenomenon, we find precisely the same indications, but the fringe lines are heavy and coarse, and he had not the advantage of photographic reproduction which I had, so that the electric work may have lost something of its original value in the hands of the engraver.

When the arc light is produced by the direct current, the positive carbon is consumed much more rapidly than the negative, while, when produced by the alternating current the consumption is equal in each. This warrants the conclusion that the relative consumption is in proportion to the relative electric energy expended, and hence that, with the direct current, the energy is much greater on the positive than on the negative side; and that the direction in which this energy moves is from positive to negative, so that in passing through the arc a large proportion of it is expended in overcoming the high resistance, which accounts for the relatively smaller consumption of the negative carbon.

Difference of potential is, of course, no evidence of the relative direction of electric movement in a conductor, and the common expression of "fall of potential from positive to negative" must be regarded as a mere conventionalism, unless it can be proved in some such manner as above that the potential called positive is higher than that called negative.

The theory of the dual nature of electricity, and of the simultaneous movement of the two kinds in opposite directions in the same conductor must be rejected as unsustained, inconsistent with the theory of difference of potential and contrary to the observed movement of kindred forms of physical energy, as light and heat. The movement of light and heat from higher to lower potential is verified by common observation, and the negative conditions of darkness and cold are known to be due to a lack of the energy which produces the positive conditions; hence, reasoning from analogy, we may infer the existence of similar physical conditions in electrified bodies, and a similar movement of energy; and recognizing each of these manifestations of energy as different kinds of molecular movement, each having its own special phase, there is no valid reason for attributing to electricity a different direction of movement from that which we find in light and heat.

AURORAL AND EARTH CURRENTS.

BY

D. B. Grandy

It is unfortunate for the cause of science that the excellent facilities for the study of auroral storms, such as those of July 16 and August 12, afforded by the network of telegraph wires extending over the country, have never, as yet, been utilized on a systematic and comprehensive plan. That they have not is due, not to any lack of willingness on the part of the companies, nor of zeal on the part of the electricians and wire chiefs in their employ, but to the fact that the time and attention of telegraph officials is wholly occupied during periods of auroral activity in devising methods to neutralize its effect and prevent a total suspension of business on their wires.

It would seem that if these officials would enlist the interest of the operators who work the wires in this subject, satisfactory results might be achieved. With a little instruction any operator of ordinary intelligence would be able to note the time an auroral current appeared on his wire, its polarity, approximate strength and time of disappearance. To illustrate: The polar relays in multiplex apparatus are arranged to close their "local" circuits and record a signal on a current of a certain polarity arriving from the distant terminal. Let us say that St. Louis relay closes on a positive current from Kansas City. When the receiving operator finds the signals growing "heavier" and his relay finally "closes," he will know, if properly instructed, that the cause is an auroral current of positive polarity, while, if the signals become "light" and his relay finally remains "open," the extra current is negative. On wires worked "single" from a + pole the neutralizing of the home current and opening of the relay would indicate an auroral + current, while an increase of strength and sparking at the key would indicate that the extra current was —. The operator could judge the approximate strength of the auroral current by its effect on the relay.

Such a record by the operators at each terminal of wires in use during auroral disturbances, properly tabulated and revised by the local electricians of the telegraph companies, would afford data for intelligent theorizing on the nature and effects of auroral phenomena more complete and reliable than we now have. If it served no other purpose, it would at least answer the question whether these currents are local and erratic in their character and due to constantly changing and reversing differences of potential between certain sections of earth and atmosphere, or have their origin in solar influences which sweep across the earth's surface like shadows of summer clouds, and give rise to vast waves of electrical energy, uniform in direction and polarity at any given time, wherever felt on the surface of our planet.

Further opportunity will possibly be afforded during the ensuing months of 1892 for study and experiment on this subject. During the last period of auroral activity, in 1882, the phenomena occurred with more or less frequency and energy, from January until September. If preparation be made at once to obtain a record of the effects of future phenomena which may occur, in the manner suggested, something definite and valuable in the way of results may be obtained during the present period of auroral activity.

The employees of the telegraph companies are a very intelligent body of men and women, to whom the idea of assisting science in solving the mysteries of nature would appeal with peculiar strength and fascination.

INSULATED ELECTRIC CONDUCTORS.—IX.

BY

James Bowstead Williams M.A.

Copal.—Copal includes several varieties of resins which are found in widely separated portions of the globe, the principal being the African, West Indian and New Zealand copals. That imported from Zanzibar is considered the best. The resins which are the hardened exudations of trees long extinct are hard and lustrous, and vary from an almost colorless transparent mass to a bright yellow brown. The true or fossil copal is mined from the earth, and is undoubtedly the best for insulating purposes.

Copal is a valuable insulating material although but little used in practice, probably on account of its cost and the lack of knowledge concerning it. Like amber, it is one of the most permanent resins known. It remains unchanged for years in air and stands comparatively high temperatures without injury. Chemical agents which dissolve or destroy other resins have little or no effect upon it. It is too brittle to be used alone, and must therefore be used in combination with elastic or flexible substances. It readily combines with most of the resins, and paraffine, when heated, and when used in suitable proportions, but not with asphaltum.

Linseed oil is its proper solvent, although a small amount of it can be dissolved in a large quantity of volatile solvents. Copal requires a special treatment before it is fit for the best solutions, and even then care and practice are necessary to dissolve it. If first combined with rosin, the solution is easier effected but the product is not so durable. Many formulæ for the use of copal are published in books and journals but are nearly all worthless. This statement will apply to the majority of published formulæ, and recipes for paints, varnishes and chemical mixtures generally. The writer has recorded scores of failures caused by placing confidence in such; hence this word of caution.

Copal is a very slow-drying resin when used in paints, but this can be remedied by baking or otherwise heating the painted articles. When combined with rubber, by means of linseed oil, it makes an excellent insulating paint. When used as an ingredient of paints it should be dissolved separately and then added to the other ingredients in solution. This should also be done when it is used as an ingredient of melted compounds; otherwise it is apt to separate from the other ingredients upon the addition of the oil which is added to impart the requisite flexibility to the compounds.

Copal and amber varnishes are commonly adulterated with cheaper resins; therefore, the safest plan is for the electrician to make his own solutions. Full directions for making these will be given later.

Animé.—This resin is a variety of copal. It derives its name from the presence of insects which were imprisoned in the oleo-resin as it exuded from the trees, and which remained embedded in the mass when hardened.

Kowrie.—This resin is considered to be a variety of copal. It is the hardened exudation of fossil trees which grew principally in New Zealand. It is dug from the earth the same as the African copal. It is easier to use than the Zanzibar copal. When used with camphor it assists the union of sulphur and rubber in vulcanized compounds.

Amber.—This is the hardened exudation of extinct conifers, and is found along the shores of the Baltic sea and other parts of Russia. It is probably the most permanent resin known and is a most valuable ingredient for insulating paints. Like copal, it is a very slow-drying resin, but the drying can be accelerated by heat.

Much of the amber sold is an adulteration, the pure resin being scarce and expensive. For insulating purposes its place can well be supplied with copal, which is practically inexhaustible, if the statements of recent African travelers are to be believed.

Solutions of amber in linseed oil are effected in the same manner as copal solutions.

Turpentine.—Turpentines are exudations from incisions in pines, larches and firs, and consist of resin combined with essential oils. The principal turpentines used for insulating material are the white or gum turpentine, Venice turpentine and Canada balsam. When they first exude they are viscid like honey but by exposure to the air gradually become harder until, in time, they become brittle. This change is due to the oxidization of the essential oils and evaporation of the volatile constituents. If heated to boiling the volatile matters are quickly eliminated, and if the heat be continued for a few minutes the turpentines are changed to brittle resins. Hence they are not suitable for compounds which require a high temperature for their production and application. If used in low-melting compounds or in paints they impart flexibility at first, but if the compounds are exposed this flexibility gradually disappears.

When pure, Venice turpentine can be combined with beeswax to form "preservative material" for vulcanized compounds. This turpentine is imported from Switzerland and is the product of the European larch; but what is often sold as Venice turpentine is made by dissolving rosin in oil of turpentine. The imported turpentine is nearly transparent, with a yellowish or greenish tint, but the manufactured material has a brown color.

Pitch.—This is obtained by distilling pine tar, and, when pure, consists of the resin of the pine unchanged. It unites with most of the resins, paraffine and asphaltum. It absorbs moisture when exposed and partially dissolves in water. This is probably owing to the presence of small quantities of tar which have not been removed by the distillation. Combining it with paraffine does not prevent the absorption of moisture when used with fibre and exposed to a damp atmosphere.

Sandarac, dammar and mastic are used in varnishes and are not suitable for melted compounds. All contain more or less moisture which should be removed by powdering and then drying in a current of warm, dry air before they are used.

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VOL. XIV. NEW YORK, SEPTEMBER 7, 1892. No. 226.

Science is a growth of time, and though man's cultivation of the field is an essential condition of that growth, the development steadily progresses, independently of any individual investigator, however great his mental power.—Josiah Parsons Cooke.

ELECTRICAL SCIENCE AND THE SCIENTIFIC AMATEUR.

IF we read aright the comments on the successive meetings of the British Association there appears be an opinion gaining ground that this world-renowned body is losing prestige and that its meetings have latterly resolved themselves into junkets which give its members opportunity to come together to have a good time, the papers read being a mere incident to the occasion. As a result it has been suggested that the Association be reconstructed upon a different plan if it is to continue to carry out the object for which it was organized. The work done by the British Association in the past, and especially in the domain of electrical science, demonstrates sufficiently that there is need of an organization, under whatever name it may be known, in which all those interested in a common object can meet on equal ground. The papers read this year before the Mathematical and Physical Section, which includes electricity, and some of which we have printed elsewhere, though not of that broad and general nature which characterizes those brought before the more specialized electrical societies, nevertheless have a value of their own which it would be folly to ignore.

But the British Association, as well as the American Association for the Advancement of Science, presents opportunities for the encouragement and even for the fostering of a class of men to whom Prof. Arthur Schuster alluded in his presidential address before the Mathematical and Physical Section at the Edinburgh B. A. meeting, namely, the "scientific amateurs." In defining this term Prof. Schuster does not necessarily mean a man who has other occupations and only takes up science in his leisure hours, but rather one who has had no academical training, at any rate in that branch of knowledge which he finally selects for study. He has probably been brought up for some profession unconnected with science and only begins his study when his mind is sufficiently developed to form an entirely unbiased opinion. We might best define an amateur as one who learns his science as he wants it and when he wants it; and in the light of this definition, Prof. Schuster would call Faraday and Joule amateurs! Prof. Schuster lays special stress on the danger we now run of losing such scientific amateurs, who constitute one great and necessary factor in the origination of scientific ideas, and the danger is to be looked for in the methods of education now in vogue. He goes so far even as to maintain that at present a knowledge of scientific theories tends to kill all knowledge of scientific fact. He considers the highly specialized entrance examinations to the scientific departments of universities a curse to all sound school education, and thinks that they will prove a still more fatal curse to the progress of scientific knowledge. Prof. Schuster, however, notwithstanding his recognition of the scientific amateur or unprofessional scientist, has done well to draw attention to the damage they are likely to do themselves and the cause of science when they overstep their legitimate boundaries, especially when they seek popular support for their theories, which have not received the approval of those competent to judge. We take it that in this lay intolerance of the judgment of the professional scientists lies the barrier which has so long separated many workers for a common end. There is much food for thought in the utterances of Prof. Schuster which are specially applicable to the domain of electrical science, now so actively cultivated in all quarters, and it is to be hoped that the science of pedagogics will advance at a rate commensurate with that of the physical sciences so as to give the beginner all the advantages which a properly trained mind has over the untrained.

THE ELECTRICAL UTILIZATION OF GARBAGE.

IT may be that the electrical sterilization of water, freeing it from the poison of such things as cholera germs, may be still in its experimental stages, though more than hopeful; but it would seem that electricity can meantime do much in the way of helping great municipalities to dispose of their garbage. New York at the present time is sadly in need of improved methods of garbage disposal, and is using its beautiful bay as a dust bin, with the result that all bathing beaches and the ocean, too, are bestrewn with the disgusting refuse of the city. The idea is that the garbage is towed out far to sea, but as a matter of fact that only happens when a storm chances to carry the barges out despite the opposition of their captains.

Prof. George Forbes, the distinguished electrical engineer who is now in this country to give personal attention to the great work at Niagara, has been interviewed by city papers on the subject of garbage destructors, and we print this week a synopsis of his recent paper before the British Association, in which he sets forth the same facts that have now been brought to the notice of the citizens of New York. His figures should be studied by all public authorities, for they certainly suggest a means for abolishing a great evil that must increase with every city's growth. Even if the garbage were merely burned up, the gain in public health and comfort would be enormous; but there is, as pointed out, the further opportunity of generating steam for large electric light and power plants.

LOW TENSION STREET ARC LIGHTING.

The growing popularity of low tension, or multiple arc lighting must have impressed every one who has watched the tendencies of electric lighting. When we see local incandescent companies and electric railway companies running hundreds and hundreds of such lights on their regular circuits, it is plain that a new and important factor in street lighting must be taken into account. As a matter of fact, a great many of these constant potential arc lamps are used on the streets, but it is still a novel thing that they should be used from end to end of an important thoroughfare. This departure has been taken, however, in the contract made last week by the New York City Gas Commission with the local Edison Company for the lighting of Fifth avenue from Washington Square all the way to Fifty-ninth street. The lights will be in pairs at street intersections, and, of course, will be supplied from the Edison underground mains without the necessity of any overhead wires. A brilliant illumination of this fine avenue is expected in place of the feeble flicker of the old gas lamps, and the experiment will be very closely watched. The influence of its success upon the lighting of leading thoroughfares in large cities must be obvious to all.

COVERED OVERHEAD WIRES.

The methods of construction adopted by electric lighting companies in this country have been made the subject of attack by most foreign electricians who have visited these shores; and it has, indeed, become the fashion even among some of our own electrical engineers to rail against the apparent backward state of the art of line construction in the United States. So far as the criticisms refer to the actual character of the workmanship, independent of the material, no one will deny the truth of much that has been laid at our door, but ought the indictment to be so sweeping, especially with regard to that most important detail, the line wire? For the objects of the present discussion, we may leave out of consideration the old "underwriters'" wire, and confine ourselves on the one hand to rubber-covered and on the other to what is known in the trade as "weatherproof" wire. That the latter can never form a complete substitute for the former goes without saying but in analyzing on another page the conditions as they exist in this country to-day, Dr. F. A. C. Perrine concludes that weather proof wire has a *raison d'être* and that with proper methods of manufacture it may creditably occupy a position of usefulness. The enormous extent to which this class of wire is employed to-day is a certain indication that it meets the wants of central station managers and that they will continue to use it as long as the higher cost of rubber-covered wire places the latter beyond their reach. But we are not advocating the employment of an inferior material of construction. It must be clear that the results which can be obtained with weatherproof wire of good quality depend largely upon the manner in which it is handled, just as in the case of rubber-covered wire. Its very hardness has been one of the causes which has led to its abuse; and care in erection has been the exception rather than the rule. It is this laxity or poorness of workmanship that vitiates many of the benefits which could be obtained with inferior materials and which often makes the very best the only safe thing to use.

Cables in Telephony.

The enforced adoption of cables by many telephone companies has had a most marked influence not only on the methods of operation heretofore in vogue, but also upon the art of cable making and using. The changes in the methods of insulation to reduce the inductive capacity of the cables have already been alluded to at length in our columns, but the influence of their introduction in the working of exchanges had still remained to be told. It is this aspect of the subject which Mr. H. Laws Webb takes up in this issue. He gives the reader a glimpse of the manner in which the cable has led to successive modifications and improvements in exchange work.

LIQUEFIED AIR AND OXYGEN.

Prof. Dewar gave a very interesting lecture at the Royal Institution recently, on liquefied oxygen and liquefied air. He produced both liquefied oxygen and liquefied air, the oxygen in pints; and even the liquefied air was handed round in claret glasses. Liquid oxygen boils in air at —182° Centigrade. The liquid oxygen placed between the poles of Faraday's great magnet behaved like a metal, leaping up to the poles and clinging to them till it disappeared as gas. But liquid oxygen, though so strongly magnetic, is a very bad conductor of electricity. It is a non-conducting magnet. He showed too, that so far as chemists can judge, there is probably no oxygen in the sun—the oxygen of the earth's atmosphere accounting for all the oxygen lines in the solar spectrum. The boiling point of liquid air is —192° Centigrade, or 10 degrees lower than that of oxygen. It is not true, as had been supposed, that the oxygen in the air liquefies before the other elements in air; on the contrary, the air liquefies as air, and is not resolved into its elements before liquefying. If this globe were cooled down to 200° below the zero of Centrigrade, it would be covered with a sea of liquefied gas thirty-five feet deep, of which about seven feet would be liquid oxygen.

INSTALLATION EFFICIENCY.

Careful experiments have been carried out with the electric plant at the Argenteuil railway station by the French Edison Company. The boilers are two of Weyher and Richmond's, engines slow speed (85 revolutions), 35 h. p. to 50 h. p., by same makers, driving Edison dynamos, 115 volts and 240 amperes at 950 revolutions. The lamps comprise 30 arcs of 6 to 12 amperes, and 95 incandescents of 10 c. p. and 16 c. p. The two extreme arcs are three-quarters of a mile apart. The test with all lamps and an added resistance gave a total of 26,400 watts absorbed. The output was 460 watt hours per kilogramme of coal, or 209 watt-hours per pound, equal practically to 5 lbs. of coal per supply unit. This was 30 per cent. better than specification, and is a result that may be regarded as very satisfactory.

NOTE ON SOME EXPERIMENTS WITH ALTERNATING CURRENTS.[1]

BY DR. LOUIS DUNCAN,

Assisted by Mr. E. R. Carichoff and Messrs. R. H. and G. E. Hutton.

THE first real representation of an alternating current curve was made by Joubert, who employed a contact piece rotating with the armature of a dynamo, touching a fixed brush at a point of the revolution determined by the position of the brush with relation to the dynamo poles. He obtained a curve for current which was approximately a sine curve. Later, in 1888, Messrs. Wilkes, Hutchinson and myself modified the method to obtain the curves for E. M. F. and current in the primaries and secondaries of induction coils. This modification was used afterwards at Cornell, where Professor Ryan and others made valuable experiments, and it has been more or less generally employed. The principal difficulties lie in the fact that with a single commutating arrangement but one curve can be taken at a time, and as an experiment involving four curves takes something like 45 minutes, the condition may seriously change; while the whole voltage of the dynamo is at times on the commutator. It is at best rather a tedious method. In our work referred to above, and in the work at Cornell, E. M. F's, were measured by an electrometer, and currents were obtained by getting potential differences at the terminals of a non-inductive resistance through which the current passed. Lately, in France, two commutating arrangements have been used to give two curves at once, with a condenser charged through the contact and discharged through a d'Arsonval galvanometer.

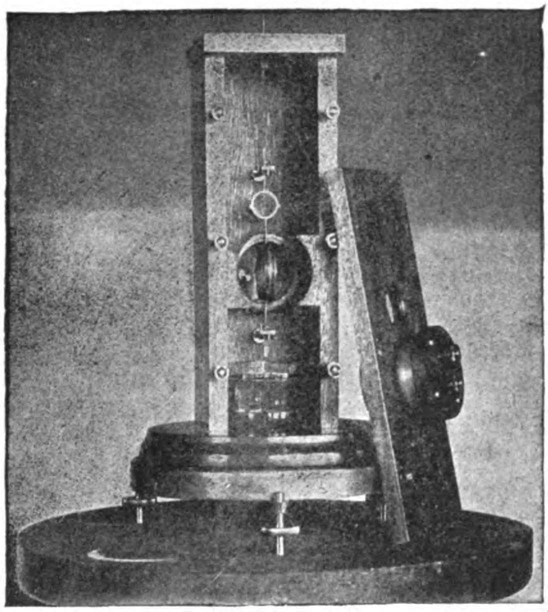

FIG. 1.—ELECTRODYNAMOMETER.

By the method which I described last fall any number of curves may be obtained simultaneously, with only a few volts on the commutator and with a rapidity and accuracy much greater than by the other methods. Briefly, a number of dynamometers are used, equal to the number of simultaneous curves to be obtained. These dynamometers are very cheap and convenient. The first ones used were made by Mr. Carichoff and myself, and were quite satisfactory, but experience having suggested some improvement, and our time being fully occupied, Messrs. E. S. Ritchie & Sons made four of them, such as shown in Fig. 1.

The four dynamometers have their stationary coils wound for—say—primary current, primary E. M. F., secondary current and secondary E. M. F. The movable coils are wound with fine wire, and are all connected in series. The E. M. F. instruments are made exceedingly sensitive so their self-induction may be made a minimum, and in series with them is placed a large non-inductive resistance, the relation of the self-induction and resistance being made such that the former may be neglected. The circuit of the movable coils is through a battery of a few storage cells to a brush which may be moved by hand through the arc of a circle, and which touches a contact-piece on the dynamo shaft once every revolution. The other end of the circuit being joined by a sliding connection with the contact-piece, the circuit is closed through the cells and coils for a short period once every revolution. The instant of closing this circuit is determined by the position of the movable brush with respect to the dynamo poles. Now, suppose an alternating current is sent through the stationary coil of one of the dynamometers. If an instantaneous current be sent through the movable coil, an impulse will be given it dependent on the value of its current and on the instantaneous value of the current in the stationary coil; as the period of the coil is great compared with the period of the dynamo, we will get a steady deflection dependent on this product. If now we move our contact brush, the instantaneous current will pass at some other point on the alternating current wave, and our deflection will be proportional to the value of the current at this point; by moving the brush through an angle corresponding to a complete wave we can plot the wave exactly, providing we have properly calibrated our dynamometer.

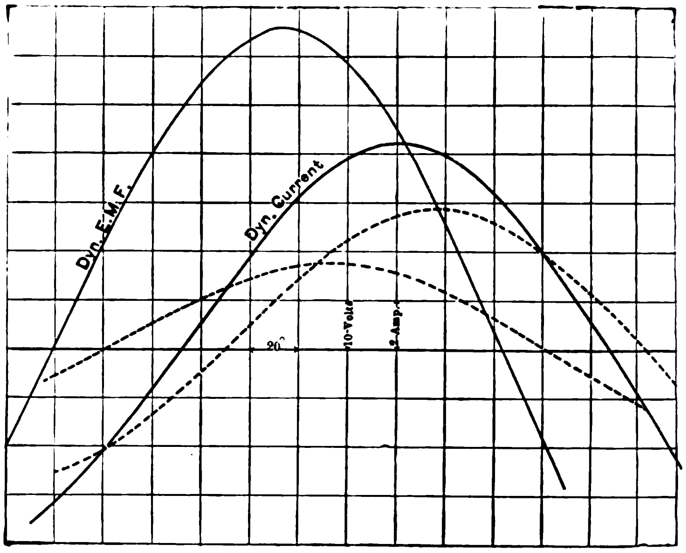

FIG. 2.—Tesla Fan Motor. Period $\frac{1}{140}$.

It is apparent that in order to attain accuracy our instantaneous current must be very brief and very steady, and its value must be the same in actual work as in calibrating. A d'Arsonval galvanometer in the circuit allows us to judge the two last points, and we found that when a high resistance was used in the circuit so that any variation in the contact resistance was eliminated, almost absolute steadiness was obtained. It was also assured by using a condenser charged during part of the revolution and then discharged by the contact brush through the circuit. To give an idea of the current in this circuit, an ordinary arrangement, when the condenser was not used, was 12 volts through 1,000 ohms, and it must be remembered that this current only passes an exceedingly small part of the time.

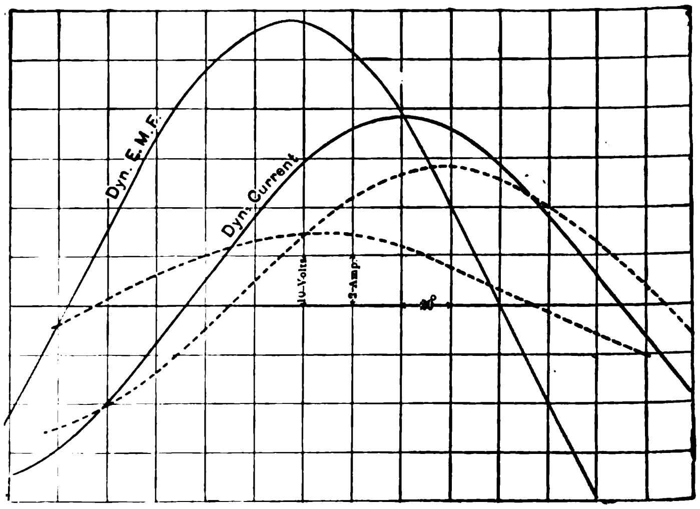

FIG. 2A.—Tesla Fan Motor—Held. Period $\frac{1}{140}$ second.

Dynamometers.—The dynamometers were made of wood, mounted on a revolving base, so they could be adjusted with respect to the meridian. It will be seen on looking at the picture that one side is made removable to facilitate adjustments. The fixed coils are wound in two cylinders which move in and out through holes in the sides, and whose distance apart is adjusted when the instrument is calibrated, so the scale divisions read directly in volts or amperes, or fractions of them. The movable coil is suspended by a silk fibre, which gives it no directive force but which sustains it. Directive force is given the coil and current is introduced to it through two palladium hair springs which are fastened to stiff brass wires, which serve as the axis of the coil. A vane in a beaker filled with glycerine damps the swinging and makes the instrument absolutely aperiodic. I have rarely used instruments which give more satisfactory results; the zero is invariable; readings may be taken with great ease and rapidity, while a reversal of the current gives equal readings on the two sides of the zero. To show the rapidity of the readings, six curves, representing different quantities in a step-up-and-down transmission were taken in a little over five minutes, and in this case two instruments were used for four curves—those at the sending and receiving ends of the plant—and therefore had to be switched from one side to the other at every reading. Twenty points were usually taken for each wave.

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[1] Abstract of a paper read at the general meeting of the American Institute of Electrical Engineers, Chicago.

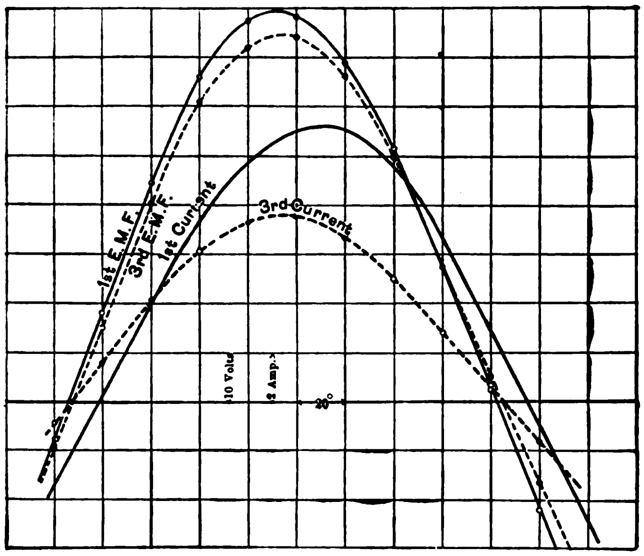

FIG. 3.

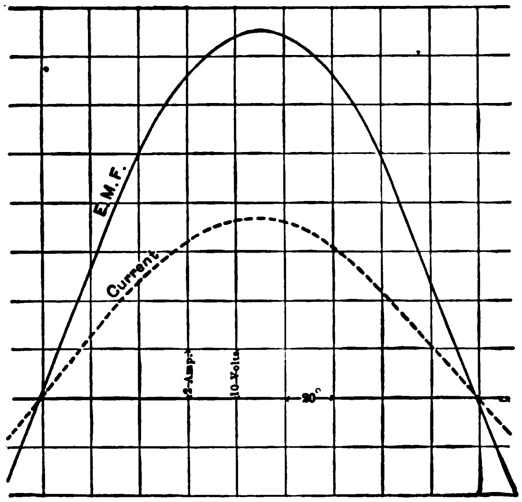

FIG. 4.—Dynamo Direct on Lamps.

The curves could of course be photographed instead of observed, but the latter is so much simpler and more satisfactory that—especially in a laboratory where there are plenty of observers—I much prefer it.

The results of our work will have to be another story. I will simply give a few to illustrate the method.

We have a small Tesla fan motor intended to work on an ordinary incandescent circuit. There are eight poles, the alternate ones having their windings in different circuits,—one set of poles having a few turns of coarse wire, the others having a greater number of fine wire turns. The curves in Fig. 2 show the condition of affairs when the motor was working; in Fig. 2A where the armature was held. In the second case the energy represented corresponds, of course, only to the losses. It seems to be the general impression, by the way, that a rotating field motor starts up with the same torque as a corresponding continuous current machine. I have shown, however, that a two-phase motor corresponds exactly to a converter—or rather two converters—in which the secondary has an outside resistance of $\frac{p^1}{p-p^1}$, where p^1 is the angular velocity of the armature and p that of the field.

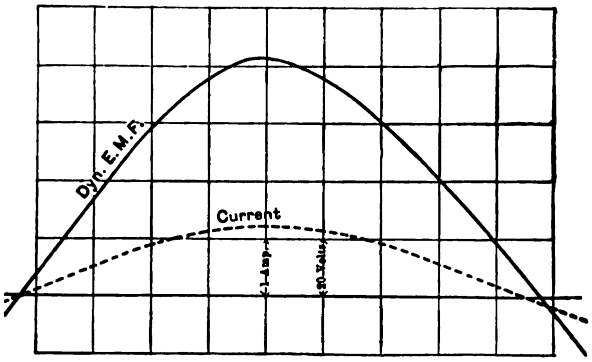

FIG. 5.—Copper Condenser with Coils.
Cap. 1.35 M. F.'S. Wire Core.

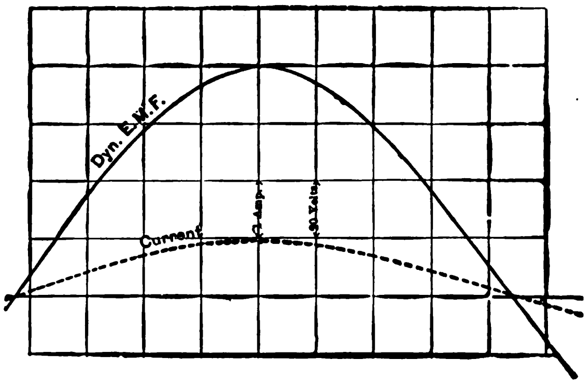

FIG. 6.—Tinfoil Condenser with Coils.
Cap. 1.38 M. F.'S. Wire Core.

When p^1 is 0—that is when the motor is at rest—it will be seen that the current is in the worst possible condition for starting and the torque for a given current is small. It is like starting a continuous current motor with the brushes almost ninety degrees from the proper position.

But most of our work has been with circuits in which both self-induction and capacity have been introduced. It is a well-known fact that circuits carrying alternating currents may be given the same period of vibration as the current, or to put it another way, circuits may be so arranged that with currents of a given period the sum of the energies stored up in the circuit and given out by

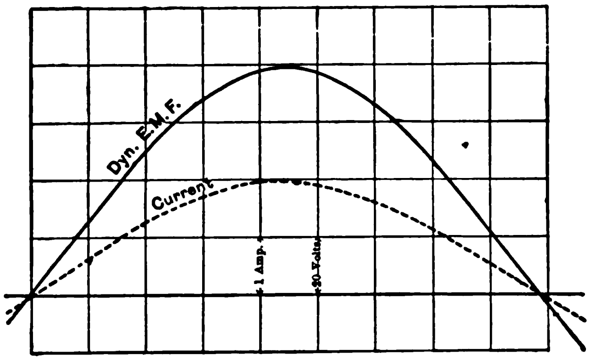

FIG. 7.—Tinfoil in Parallel with Copper Condenser with Coils.
Cap. 2.675 M. F.'S. Wire Core.

it, is zero. With a condenser and self-induction properly adjusted, if energy from the current is being stored up in the condenser an equal quantity is being given to the current by virtue of the self-induction. That is, we can neutralize our self-induction by a capacity. I can hardly think of any fact more likely to play an important part in the future of alternating current work. For instance, if a circuit has in it a periodic current consisting of a number of sine curves of different periods—one-third, one-fifth, one-seventh, etc., the period of the fundamental wave; then if we put in inductive relation to this circuit another circuit whose period is, say, one-third that of the fundamental wave, this current will pick out the one-third period waves in the primary.

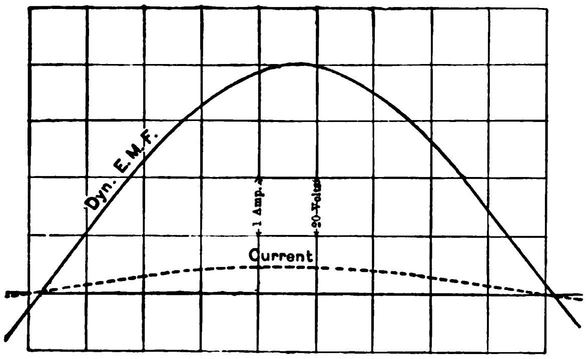

FIG. 8.—Tinfoil in Parallel with Copper Condenser with Coils. Cap. 2.675 M. F.'s. Solid 1¾" Iron Core. Resistance of Circuit, 20.3 ω.

An ordinary sine curve E. M. F. may be made to give a periodic current wave with these higher harmonics in several ways—by having in the circuit a self-induction coil whose iron core is saturated when the current nears a maximum, or by using the same coil with a capacity which neutralizes one of the value of the varying self-induction; so we can produce these higher harmonics and we can pick them out. But it is a complex subject not to be treated here. In all such experiments, however, there are several points which must be carefully attended to, or there will be very unsatisfactory results. If the iron core of the induction coil—provided such a core is used—is not properly laminated and annealed, or if there are considerable losses in the condenser, the results will be disappointing. Take the case, for example, where there are eddy currents in the core and there is loss in the condenser. The first effect corresponds to a short-circuited secondary near the coil; the loss in the dielectric of the condenser means that energy is taken from the current, and this energy must be represented by the product of the current into the E. M. F., *e* corresponding to the transfer of energy, or it is $e.\ i$. The value of *e* is a maximum when the displacement is greatest—that is when the current is greatest, and for a given current and dielectric varies as $\frac{1}{c}$. If we represent these effects by a revolving diagram, as is ordinarily done, and suppose we have neutralized the self-induction by a capacity, we get something like Fig. 10. The result is that the relation between R. I. and E. instead of being 1 to 1, as would be the case were there no disturbing causes, is 1 to 1 +. That is, for a given E. M. F. the current is less than it should be, and a glance at the figure will show that it is thrown ahead of the E. M. F. No possible change in our self-induction and capacity can remedy this decrease in the current, although we may, of course, make the phase anglo zero if we wish.

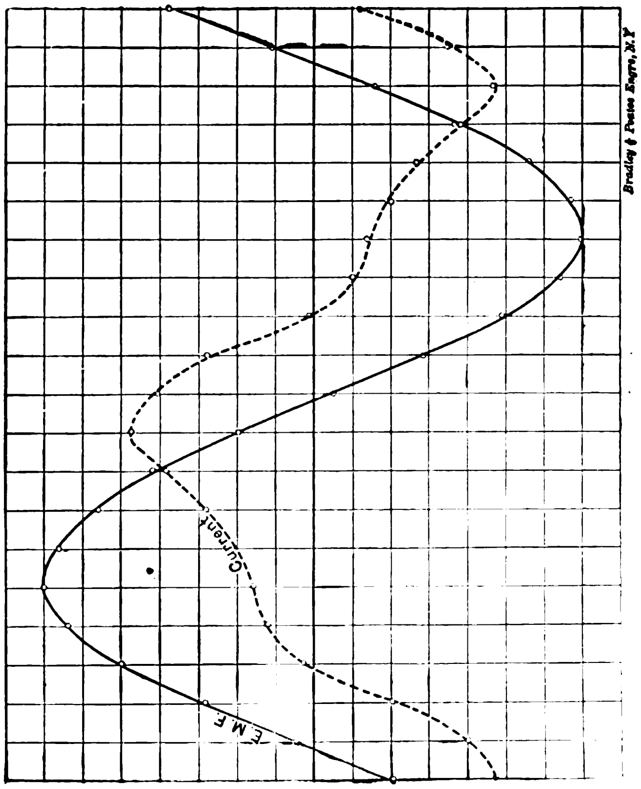

FIG. 9.—Siemens Dynamo on Transformer; Secondary Open. Curves Taken with Experimental Dynamometers.

An excellent way to make an iron core, by the way, is to shellac fine, well annealed wires, spread them along a piece of thin paper, brush them over with shellac and then roll the mat so formed into a cylinder. The losses in a condenser are usually small. They are discussed in a paper of Messrs. Hutin and Leblanc, published last spring in *La Lumiere Electrique*. We find, however, that if the condenser is made of very thin tinfoil and has a large area, then for heavy currents it may considerably decrease in capacity and offer a definite resistance to the current.

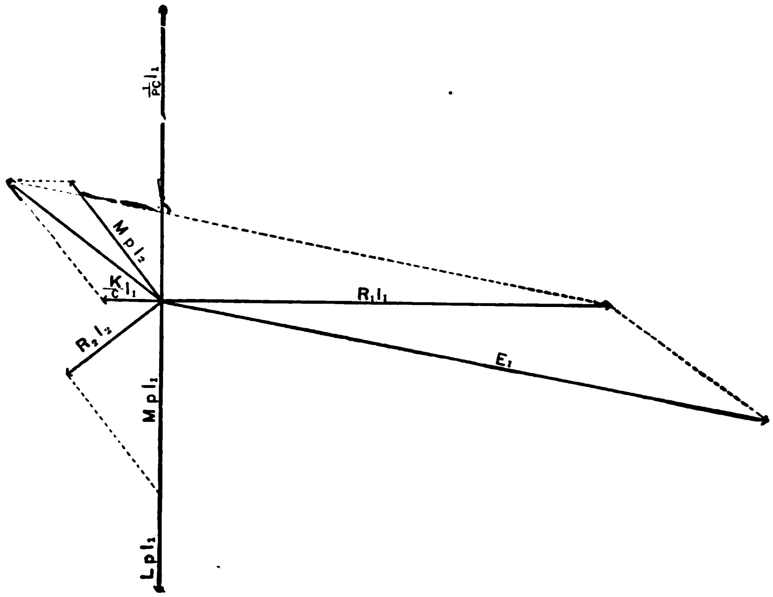

FIG. 10.

The curves given have been selected almost at random from a mass of data. We have not the time to discuss the results which are hardly within the scope of this paper. Fig. 3 gives the curves at the two ends of a transmission plant where the voltage was raised from 50 to 1,000 volts and reduced again. Fig. 4 gives the curves for the dynamo directly on the same lamps. It is seen that the transmission decreases the E. M. F. and current, and increases the lag of the dynamo current.

Figs. 5, 6, 7 and 8 give curves taken from the dynamo circuit when self-induction and capacities were inserted. In Fig. 5 the core of the induction coil was only fairly well laminated; and a condenser with copper sheets between paraffined paper was used. The maximum current is a little over 1.2 amperes, while it should have been about four amperes if there were no losses in the circuit. The second point of crossing is thrown out by a change of speed of the dynamo. Fig. 6 shows the result of substituting a tinfoil condenser of the same capacity in place of the copper one. In Fig. 7 both condensers were used and a considerable part of the wire core was withdrawn. In Fig. 8 with the same two condensers, a solid iron bar was used as the core of the induction coil.

Fig. 9 gives the curves obtained in the circuit of a dynamo connected to a transformer whose secondary circuit was open.

MR. JOHN R. MARKLE, the well-known fuel, gas and electrical expert, of Detroit, Mich., called at the Western office of THE ELECTRICAL ENGINEER during a visit to Chicago on special business pertaining to electrical matters.

APPLICATION OF DESTRUCTORS, PARTICULARLY TO THE ELECTRIC LIGHTING OF EDINBURGH.[1]

BY PROF. GEORGE FORBES, F. R. S.

THE object of this paper, said the author, was to enable the citizens of Edinburgh to see the enormous natural advantages which exist in their city with relation to electric lighting. The advantages were such as would enable the people of Edinburgh to obtain the electric light at a price lower than gas, which could hardly be considered possible in any other town. First, as to the use of destructors, that was, the use of furnaces for burning the city ash bin refuse, which was recognized as the best way of geting rid of refuse, and the means of using these destructors for fuel to generate steam. Referring to any load diagram of an ordinary central station, they would find that during the greater part of the day the machinery and boilers were lying idle; for two hours only were they working at their maximum. To have these dynamos and engines standing without earning any money was very serious, but there was another serious result, and that was that the boilers required to be fired up for simply a two hours' run. Every engineer knew what a low efficiency there would be from coal used in that manner. The only cure for this difficulty was some system of storage. The president of the section had referred to the storage by means of hydraulic accumulators, which Lord Armstrong has so largely introduced; he has also alluded to storage—hydraulic storage in reservoirs—both at Geneva and Zurich. It was exactly following out those ideas that the author would suggest how the difficulty of storage should be overcome in Edinburgh. The reason why Edinburgh was peculiarly well situated was, that there was very high land in the immediate neighborhood of the town—he referred specially to Arthur's Seat.

The author's first notion was to use Dunsapie Loch as a reservoir, the idea being that a steam engine should be used at the lower level, continually pumping water up to the high level, and at the lowest part of this, pipes and turbines should be attached for driving dynamos; this arrangement was exactly the same as that employed at Zurich. A further examination and consideration of the locality showed that by a slight additional expense they gained enormous advantages. Looking from the summit of Arthur's Seat, in the direction of Portobello, there was a gully which, by means of a very short dam, would enable them to make a reservoir which would not be in the least unsightly to the neighborhood of Edinburgh, and, in fact, would be invisible save from the Portobello side of the hill. If such a dam were built, the pipe line would then be taken down to Lochend, nearly a mile distant. The height of the reservoir would be 725 feet, and the height of Lochend 83 feet; they might also use Dunsapie Loch and St. Margaret Loch—in fact there were several ways of doing the work. If Dunsapie were deepened to 10 feet, it would contain a million and a quarter cubic feet of water; but by building a dam near the summit of Arthur's Seat they got a quantity of water equal to 28,000 h. p. working for an hour, that is, on the assumption of 75 per cent. efficiency on the turbines and pipes. The cost of the pipes carried from the summit of Arthur's Loch came out at the rate of £1 per horse power. They would be able to see what could be done with this horse power. The Berlin load curves showed that the maximum demand on a mid-winter day was four times the mean; secondly, if engines were constantly supplying power, storing what was not wanted, the storage capacity must be equal to maximum output working for about two hours; thirdly, the maximum output at any moment in the year was about six times the mean output of the whole year. Working from these facts, the author found that there can be obtained from the 28,800 h. p. hours available in the reservoir, a maximum output in the central station of 12,500 h. p., and that 3,000 h. p, continually working in the form of steam engines, would make a total of 15,500 h. p. There is by this means saved the cost of 12,000 h. p. boilers and engines which would probably cost £200,000, replacing it by pipes and turbines, pumps and reservoir, probably costing not more than £35,000 altogether. Pumping engines and turbines were now so perfect that it would be possible to get a horse power delivered from 3 lbs. of Welsh coal. Experience showed that, including the coal wasted in getting up steam and banking fires, even when using the best appliances of the modern central station, 5 lbs. of coal at least was required for every horse power. There was then a saving of about 2 lb. of coal per horse power by keeping the engines working at their maximum. The maximum demand in winter was six times the mean of the year; thus, with a maximum of 15,625 h. p., there was a mean output of 2,600 h. p. all the year round. A saving of 2 lbs. of coal per horse power hour amounted to 20,000 tons, which at £1 per ton meant a saving of £20,000 per year. These facts illustrated very clearly the enormous advantage of storage, which could be so easily gained by utilizing the natural anvantages of the city of Edinburgh.

The author then dwelt on the advantages of the use of destructors. There was no doubt that the use of destructors for getting rid of refuse, and for getting up steam for electric lighting purposes, would play an important part in the future, but in most towns it would be impossible to get the full advantage from the destructors, because they must be burning refuse day and night, whereas for electric lighting purposes, or the distribution of power, it was only during certain times of the day that there was a demand, so that the heat from the destructors was wasted for the greater part of the day; but by the hydraulic storage in Edinburgh they would be able to use destructors with the greatest advantage. After a reference to the destructor at Leeds, the author said that steam had not been largely used at Leeds, but at Southampton and one or two other places it had been largely used. At Southampton the boilers (locomotive) were simply placed in the main flues, without any attempt to drive the products of combustion through the flues, with the consequence that there was a very bad economy, and it required 75 lbs. of ash bin refuse to give a horse power for one hour. The author had made numerous experiments on the heating properties of ash bin refuse, and there was not the slightest doubt that in the great majority of towns the ordinary ash bin refuse as a heat-producing power would mean that 10 lbs. would equal 1 lb. of ordinary coal.

ON THE DIELECTRIC OF CONDENSERS.[1][2]

BY W. H. PREECE, F. R. S.

ARTIFICIAL cables are very useful adjuncts to the laboratory of the telegraph engineer. They not only enable him to experiment at his leisure, but they form very useful means to test and compare high speed and delicate telegraph apparatus, and especially telephones. I have one, made some years ago, which has been in incessant use; composed of 54 inductionless coils of insulated copper wire, each giving 33 ohms resistance, and having a condenser of 1 microfarad capacity at the juncture of each pair of coils. This represented a circuit of a total capacity (K) of 54 microfarads and of a total resistance (R) of 1,188 ohms. The K R being 64,152. This was equivalent to an ordinary submarine cable of 162 nauts length. It was not sufficient for our growing wants, and another precisely similar set was recently made of the same dimensions and materials and in the same way. But it did not give the same results. The resistances were exactly the same, but the individual capacities differed so much that the total capacity for the same surface of foil was 60 microfarads instead of 54, so that the K R was 71,280. This difference, of nearly 11 per cent was, of itself, of no practical consequence for the particular purpose for which the cable was constructed, but on carefully comparing the two "cables" with telephones, it was found that with the same nominal K R the new one gave 30 per cent. better results than the old one; that is, with the same nominal K R and the same telephone speech would be 30 per cent. clearer on the new "cable" than on the old one. The limiting distance of speech would also be 30 per cent greater on the new one. This was a surprising and unexpected result. I thought it might be due to inductance, but none, neither *self* nor *mutual*, could be detected.

The insulation, taken after one minute's electrification of each, was:

Old cable 172.8 megohms per naut.
New " 82.8 " " "

so that the difference was in favor of the old one. But the electrification of the new one was much superior to that of the old one. The difference in the resistance reading between the beginning and ending of the first minute on the former was $\frac{1}{10}$ of that of the latter.

Each cable was then rapidly charged and discharged 1,200 times, at varying rates, with an E. M. F. of 40 volts, and the cumulative remaining charge in each case read by reflection on a Thomson galvanometer. This was done by passing a 10-foot length of perforated slip through a Wheatstone automatic transmitter. The following are the results:

Number of discharges per second.	Discharge.		Percentage difference.
	New.	Old.	
20	46	28	39
40	86	55	36
80	151	100	33
120	200	136	32
160	237	168	29

This clearly shows that the effect is due to absorption. Electrification, polarization and absorption are phases of electrolytic work done by the current upon the dielectric. The material is slightly decomposed by the leakage current, a counter E. M. F. is set up, which reduces the apparent resistance (electrification); it gives a current of discharge reverse to that of charge (polarization); it absorbs a quantity of electricity, the undissipated part of which is recovered as a discharge current. The condenser acts, in fact, like a secondary cell.

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[1] Abstract of a paper read before the British Association, Edinburgh.

[1] Lord Kelvin proposes to call this useful instrument a "Leyden," because the term "condenser" is applied to other more appropriate mechanical and physical apparatus.

[2] A paper read at the B. A. meeting, Edinburgh.

We are now using better paper than formerly—that made from the best linen rags, thinner tinfoil and better wax—the best refined unadulterated white paraffine, having a melting point of from 125° to 128° Fahr. Resin was formerly mixed with the wax, and when hot and liquid, it was painted on the paper with a brush. The paper is now thoroughly dried, and well saturated with wax, by soaking under pressure, so as to get rid of all the moisture. Hence there is less electrification and less absorption, and consequently less retardation, and hence the superiority of the new "cable." In the old type of condenser we observed a variation of capacity, due to temperature; but in the new type this has disappeared. This effect of absorption on the effective capacity of the condensers, and of insulated conductors, is new to me, and as it may be new to many others, I have thought it to be of sufficient interest to bring it before the section.

It is a new term to be added to the question of energy of compound circuits, and it has evidently a material influence upon the retardation of signals in long submarine cables. It has an equally important influence on the efficiency of telephone circuits, and it accounts partially for the great difference in my K R law between the observed effects of aerial and those of subterranean or submarine conductors. The former are always much superior to the latter. This would be due to the absence of polarization in air as well as to other electromagnetic and electrostatic causes. No work would be done on the molecules of air, no energy would therefore be absorbed, and no retardation of currents from this cause would ensue. An air dielectric is clearly the "Holy Grail" of the electrician.

POWER TRANSMISSION BY ALTERNATING CURRENT.[1]

BY GISBERT KAPP.

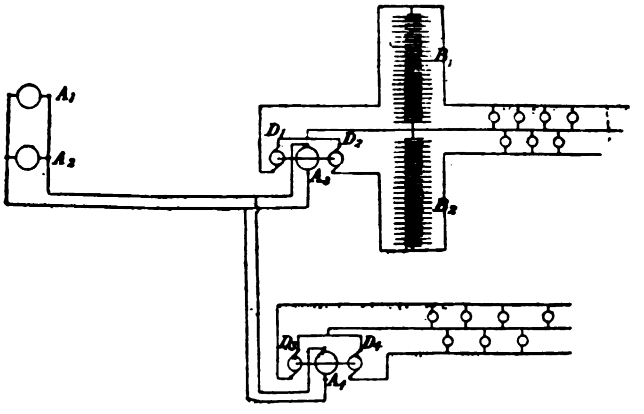
SOME two years ago the municipal authorities of Cassel, in Germany, determined to become purveyors of electric light and to place the generating station on the site of the water-works pumping station, which is situated on the River Fulda about four miles from the town. The object in choosing this site was partly to bring both undertakings under the same management, and so reduce administrative expenses, but chiefly to utilize an existing turbine plant which had been erected for driving pumps to augment the natural supply of water by gravitation, which was found in the hot summer months to be scarcely sufficient for the requirements of Cassel. The gravitation supply being abundant during the rest of the year, the turbine plant and an auxiliary steam engine erected as a stand-by to the turbines represented so much idle capital during all the time that motive power was not required for pumping. It was thus obviously good policy to put the central electric station on the site occupied by the waterworks, using for motive power the turbine plant and stand-by engine already existing, and this the more so as the two services, namely, water and light supply, do scarcely, if at all, overlap. In summer when the greater part of the power obtainable from the turbines is required for pumping, the demand for light is a minimum, whilst in winter when the whole of the turbine power is required for lighting the pumps need not be worked, the water supply by gravitation being, as already stated, amply sufficient.

The problem was solved in a very successful manner by a German engineer, Herr Oskar von Miller, who had been called in by the Municipality to carry out the work. The plan adopted by von Miller was briefly this: He determined to transmit power by single phase alternating current from the generating station to a sub-station or rather to two sub-stations in Cassel, and to use this power for the supply of direct current on the three-wire system. At one of the sub-stations he established a battery which is charged during the hours of light load, and assists the dynamos during the hours of heavy load, so that the maximum power available shall suffice for 3,500 16 c. p. lamps wired.

The general arrangement of this installation is shown in the accompanying diagram. A_1 A_2, are two 60 K. W. alternators at the generating station. These can be used singly or in parallel, and the current is transmitted through an underground concentric cable over a distance of about four miles to the sub-stations shown on the right of the diagram. The sectional area of each conductor is .093 square inch, and the total resistance about 3.5 ohms. The alternators are designed for a terminal pressure of from 2,000 to 2,200 volts, so that the loss in transmission, when both are working full power, is under 10 per cent.

Each sub-station contains an alternating continuous current transformer, consisting of a 60 K. W. alternator, A_3, A_4, coupled with two continuous current dynamos, one on either side, D_1, D_2, and D_3, D_4 respectively. The latter machines are connected with each other and with the mains in the usual way adopted in three-wire distribution. At one of the sub-stations there is a battery, B_1, B_2, also arranged on the three-wire system. The mains throughout the district are coupled so that the battery sub-station can supply current to the other sub-station through the town mains. To start any one of the two transformers it is only necessary to switch on the two dynamos which begin to work as motors, and after observing by a synchronizer that the speed of the alternator has reached the required amount to close the high pressure alternating current switch when the alternator works as a motor supplying power to the two dynamos which are directly coupled to it. It will thus be seen that not only are the two alternators at the generating station worked in parallel, but also the two sub-station alternators erected in different parts of the town are worked in parallel. The dynamos are Brown's design and the alternators are my design, both made by the Oerlikon Engineering Works, but I must distinctly state that I can claim no credit whatever for the Cassel installation; and that the whole credit for this (probably the earliest) example of power transmission by alternating currents is due to von Miller who, at a time when most electricians were still in doubt as to the possibility of parallel running, boldly laid down a plant, the success of which was not only dependent on parallel running, but also on the economical and safe transmission of power by single phase alternating current, using for this purpose the ordinary type of alternator as made for lighting. The plant was started on May 15 last year and has been working since then without a hitch.

By the courtesy of Herr von Miller I am able to give the following readings of the working of the battery sub-station taken at my request about a month ago. Although at that time of the year the load is necessarily light the total efficiency of the transformer, even if we neglect the correction due to lag, is satisfactory.



POWER TRANSMISSION PLANT AT CASSEL, GERMANY.

ALTERNATING TO CONTINUOUS CURRENT TRANSFORMER.

Alternating Current Motor.				Continuous Current Generators.			
				Machine I.		Machine II.	
Speed.	Exciting Current.	Terminal Volts.	Armature Current.	Volts.	Amperes.	Volts.	Amperes.
500	10	1,820	23	130	120	134	130
460	10	1,800	20	112	120	113	120
475	10	1,840	20	111	125	117	115
475	10	1,800	22	120	128	116	118
470	10	1,800	22	112	127	128	110
465	10	1,820	22	122	115	120	122

THE CONOVER MANUFACTURING CO.

THE CONOVER MANUFACTURING CO., of 95 Liberty street, builders of independent belt and steam-driven air and circulating pumps and condensers, have published an extremely attractive catalogue descriptive of their specialties. The pamphlet has a tasteful cover of blue and gold, with the name of the company in relief, and, together with the excellent wood cuts it contains, is from the hands of Messrs. Bartlett & Co. An illustrated description of the Conover independent condenser appeared in THE ELECTRICAL ENGINEER of June 29.

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[1] Abstract of a paper read at the British Association meeting, Edinburgh.

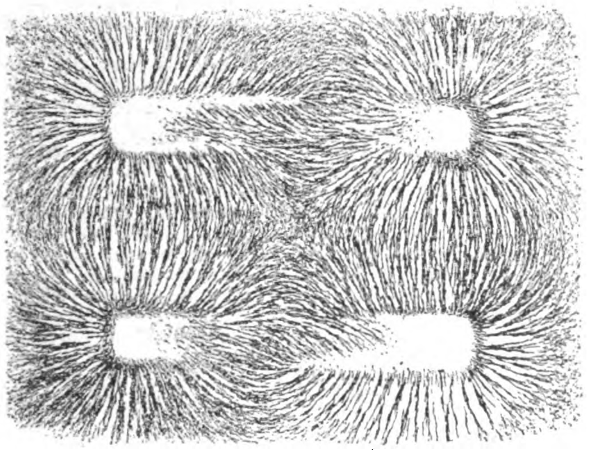
SOME ADDITIONAL NOTES ON THE GRAPHIC REPRESENTATION OF MAGNETIC FIELDS.[1]

BY PROF. EDWIN J. HOUSTON.

In a paper read at the last meeting of the section, entitled "A Graphic Representation of the Magnetic Field,"[2] I described a process for readily fixing and reproducing the peculiarities of different magnetic fields, which consists essentially in forming the fields on wax-covered plates, subsequently fixing the same by gently warming the wax, and employing the plate so prepared as a positive from which photographic prints can be readily obtained. I also briefly described in the same paper a different process for the ready reproduction of such fields, in which the collections of filings are formed in the dark photographic room, directly on the sensitized surface of a plate, which is afterwards exposed for a few seconds to actinic light and subsequently developed, and promised a further description of this method at this meeting.

It will be readily seen that this process differs from the other, in that it produces photographic negatives, in place of the positives formed by the former process.

All actinic light being excluded from the dark room, and the red light being turned down as far as will permit the plate to be seen, when the eyes have become accustomed to the dim light, a sensitized gelatine plate is placed with its sensitized surface upwards, on, or a short distance above, the magnet whose field is to be obtained. Iron filings or bits of wire are then carefully dusted over the sensitized surface, and obtained thereon, in characteristic groupings, by gently tapping the plate with a pencil or similar object in the usual manner. The plate is then exposed to the light of a gas jet for a length of time that will of course depend on the nature of the plate, its sensitometer number, and the character of the effect it is desired to obtain. When very rapid plates are used, the time during which a gas burner can be turned on and off is sufficient. I have, however, obtained the best results from the light of an ordinary friction match held above the plate and at a distance from it of about twelve feet. The match is lighted and immediately blown out. Even this short exposure appears to be greater than is required. With fairly slow plates I have found that an exposure of about three seconds, with a two-candle gas jet, at a distance of about four feet from the plate, gives excellent results. The plate is then turned on edge so as to allow the filings to fall off its surface, and any dust that remains is carefully removed by a camel's-hair brush, and the plate is developed in the ordinary manner.



Magnetic Field Direct from Photographic Plate.

Since it is desired to obtain sharp contrasts of black and white, the best results are obtained by the use of bromides in the developer for the purpose of retarding the rapidity of development. After developing, the plate is treated for a few moments to an alum bath, and is then fixed in the hypo bath as usual.

A number of plates of fields analogous to those shown in connection with his previous communication were exhibited by the author, one of which is shown in the accompanying engraving.

NEW YORK ELECTRIC CLUB.

Resuming promptly with the close of the summer vacation period, the New York Electric Club has thrown its doors wide to returning members, and on Thursday evening last opened its restaurant again under the care of a caterer, who will be on the premises and will make it his special duty to meet the demands in that department. A number of members visited the club house on Thursday, and expressed their great pleasure at finding things on their old footing. The club is to-day as cosy and comfortable as it ever was, and it is believed that electrical men in the city and from out of town will delight, as heretofore in making it their rendezvous and headquarters.

BUYING SUBMARINE CABLE ABROAD FOR THE GOVERNMENT.

In addition to the interesting letters in regard to the Lake Huron Signal Service cables published last week, from the manufacturers of Day's Kerite, Bishop and Habirshaw cables, we are glad to print the following from Prof. M. W. Harrington, the Chief of the Weather Bureau, on the same subject:

U. S. Dept. of Agriculture,
Weather Bureau,
Washington, D. C., August 27, 1892.

Editor Electrical Engineer,
203 Broadway, New York City.

Dear Sir.—In reply to your favor of the 24th instant, and the suggestions in the editorial from The Electrical Engineer, I would say that the estimate for the cost of the cables in question was made by my predecessor some two years ago, and the matter came up again during the last session of Congress. I found on investigation that the cost of the cable had about doubled, and so stated. This, I presume, is due in part to the duty; it may also be due to the increase in the price of the cables; but that matter I have not specially investigated. It was not my intention to have this cable necessarily foreign; when we are ready to purchase it we will submit specifications for bids from both native and foreign manufacturers, and select that which seems on the whole cheapest and best, as allowed to do by law.

The specifications have not yet been made out, as there is some delay in the matter of laying the cables.

Very respectfully,
Mark W. Harrington,
Chief of Weather Bureau.

We are also in receipt of the following:

STANDARD UNDERGROUND CABLE CO.

Pittsburgh, Pa., August 29, 1892.

Referring to your valued favor of August 23d, enclosing copy of an editorial from the pages of the August 24th issue of your publication, I beg to say that I do not believe there is at present any manufacturer of cables in this country equipped with the plant necessary for making submarine cables of great length, say fifty to three thousand miles, but there are no doubt several who are equipped for the manufacture of cables from one to ten miles long) and, perhaps, even forty to fifty miles long, so that there should be no necessity of going abroad for a seven-mile submarine cable.

As you are doubtless aware, there has been little or no demand in this country for submarine cables over ten miles in length, all submarine cables of great length being laid by foreign companies generally under subsidies from foreign governments, and, naturally, this has stimulated English manufacture of this class of cables.

It would be disloyal to our own country, as well as shutting one's eyes to the past history of manufactures in this country, to say that if a sufficient demand existed in the United States to justify it, there would not be plenty of manufacturers enterprising enough to put in the plant requisite to meet such demand; of course, no such plant will be put in unless the differences in prices of raw materials are secured to American manufacturers by an import tariff on the finished article.

Standard Underground Cable Co.,
Per J. W. Marsh,
Vice-President and General Manager.

BLOCK SIGNALS ON THE NEW JERSEY CENTRAL.

The Central Railroad of New Jersey has begun running its trains by the pneumatic signal system, which was recently completed by the Union Switch and Signal Company of Pittsburgh. The semaphore blades work automatically, by means of electricity and compressed air. The power stations are at Communipaw, Roselle and Greenbrook, and the new system is operated as far west as Bound Brook. When a train enters a block, both the red and green semaphores are set so that another train coming behind will be signaled to stop. As the train leaves the block, the red arm drops, leaving the green arm extended, showing that the train is in the second block. When both blocks are clear, both semaphores are down. The signal posts are about half a mile apart. No train is permitted to enter a block till the signal shows that the track is clear. The company decided to put in the new system as a safeguard because of the frequency with which fast suburban trains are run over its tracks between New York and Bound Brook.

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[1] Abstract of a paper read before the Electrical Section of the Franklin Institute, June 23, 1892.

[2] The Electrical Engineer July 20, 1892.

Literature.

The Practical Management of Dynamos and Motors. By Prof. Francis B. Crocker and Dr. Schuyler S. Wheeler. New York: *D. Van Nostrand Co.*, 1892. Cloth, 5 x 7½, 98 pages. Price $1.00.

THAT large and ever-increasing body of those placed in charge of dynamo-electric machinery must, of necessity, for the most part be recruited from the ranks of the mechanical trades, while not a few among them have had no previous mechanical training whatever. To enable such to maintain the machinery placed in their charge at its highest efficiency is an object worthy of the best efforts of all whom experience has taught that it is in little things that the successful operation of such machinery must be looked for. The publication in our columns of a series of articles under the title given above has been followed by such a demand for the issues containing them that the authors have very wisely determined to reprint them; and collected as they are now in a handy form their value will, if anything, be enhanced.

The authors divide their subject into two parts. The first treats of the general principles of dynamos and motors and relates to those important details which should govern the selection of such machines and their installation. We here find the purchaser's attention drawn to the construction and finish, the method of regulation, form, weight, cost, etc., of the various machines. The installation of the dynamo with its pulleys, belting, electric connections, etc., is thoroughly explained and elucidated by numerous diagrams and engravings, and the book includes various types of shunt, series and alternating current machines. The method of *starting* machines of these various types—a matter of no small importance—is fully gone into; while the subject of *stopping*, a probably not less important detail, receives its due share of attention. The authors also include general instructions for the use of dynamos and motors and rules for personal safety. For those who desire to enter more deeply into the determination of the quality of the machines they are handling, an excellent chapter of directions for testing dynamos and motors is given, in which the rules and apparatus employed are of the simplest kind.

Aware of the fact, however, that even the best designed and constructed motor or dynamo is apt to get into trouble, the authors have devoted Part II to a systematic treatment of the localization and remedy of the troubles met with in such machines, such, for example, as sparking at the commutator, that most prolific source of annoyance. The various rules for determining and localizing heating in fields or armature or bearings, noise, irregularity in speed, failure of motor to stop or start, etc., are all gone into with considerable fullness.

With the contents of this little volume thoroughly mastered, an intelligent person ought to be able to maintain a dynamo or motor in the best possible condition for work; and as such it ought to be in the hands of every one operating such machinery. Even those abundantly experienced in the maintaining of dynamo-electic machinery will find it of value as including within a narrow compass the many points which at the time are most vital and are apt to be overlooked in the search for trouble. The intensely practical nature of the book throughout is not the least important of its many valuable features, and the little work will not fail to increase the reputation, as well as the popularity, of the authors.

Electricity: Its Theory, Sources and Applications. By John T. Sprague. Third edition, thoroughly revised and extended. *E. & F. N. Spon:* New York and London, 1892. 647 pp.; 5x7½ in. Price $6.

ELECTRICIANS have now become so accustomed to incessant changes and modifications in existing practice and theory that they are apt to lose sight of the really remarkable changes in both, which have been brought about during the last ten years. It is only when the progress so made is systematically recorded and placed, as it were, in "parallel columns" to that of a decade ago that we begin to realize the pace at which we are going. The author whose work is before us has already fully demonstrated that in addition to being an accurate and painstaking recorder of facts and an able analyzer of subtle distinctions, he is possessed of an independence of thought which, though it may lead him to differ from well-recognized authorities, gives his work that freshness and vitality of expression which interests the reader and acts as a mental stimulus to the student.

The general treatment and the divisions of the subject-matter of the present volume are in the main similar to those of the previous editions, but the author has evidently gone over his previous work critically in the light of modern theory and practice, and with the result that we have a most excellent exposé of the subject brought down to within a few months. Thus we find most excellent chapters on static electricity, magnetism, galvanic batteries, measurement, current electromagnetism. electric lighting, electro-metallurgy, terrestrial electricity, etc., in which we believe we are safe in saying that the data to be found is that of the best practice of to-day; and with the clear enunciations of the principles as stated by the author it will give the reader a thorough insight into the various subjects treated.

We have intimated above that the author takes nothing for granted, and as a result he is by no means in sympathy with most modern theories, many of which are based upon assumptions for which he conceives there is no warrant in fact. The views recently put forth by Dr. Lodge seem especially to irritate Mr. Sprague. According to the theory adopted by him, "electricity is not a material or a quasi-material fluid, nor is it a special force or energy; much argument has been used by partisans of each of these views, to prove the other erroneous, and both sides are quite successful in the effort. But unite the two and we have a clear truth. It is energy charged in a special manner upon ordinary matter, and developing special relations among its molecules." As a result the author deprecates the present general tendency to fall back upon the ether alone as a universal agent for the explanation of all electric phenomena. This idea, to his thinking, "is naturally most favored by mathematicians and to all but trained mathematical minds it is nearly incomprehensible and appears only a modification of the one-fluid theory."

On the subject of light as an electrical vibration the author again falls foul of Dr. Lodge, who, he claims, has no evidence to substantiate the idea that "light is an electrical vibration," while on the other hand he holds that there is much to support the view that "light is a vibration of matter which may be produced by many processes which release or set in action the inherent functions of the atoms." We have given the above quotations merely to illustrate the author's independence of thought, and while we are not prepared in every instance to lend support to his own ideas on the subject, they certainly deserve, and will receive, respectful consideration, and are withal interesting.

It would take us too long to follow out in detail the many views to be found in this practically new work. We note, among many other things, that the author believes that the henry is pretty sure to be the name of the unit of inductance, notwithstanding the adoption by the Paris Congress of 1889 of the term "quadrant." We are glad to see the book brought down to so recent a date as to include the work of Mr. Tesla, which the author describes in a brief but exceedingly clear manner. The general extreme accuracy is notable throughout, but it would have been strange, indeed, if a few errors had not crept in, and among others we note a slip in the statement and the formula of Mr. Steinmetz's law on hysteresis. The exponent of *B*, representing the lines of magnetic force per square centimetre, is given as ⅙, whereas it should be 1.6. In the definition of the term choking coil the author appears to limit its employment to circuits carrying "intermittent" currents. If the author conceives the alternating current to be a species of intermittent current we have no fault to find with the definition, but we think the term employed is somewhat ambiguous and is apt to lead to error in the minds of the readers.

The work, as a whole, brought up to date as it is, constitutes a complete compendium of the subject, and, we are safe in saying, constititutes one of the few standard works on electricity in the English language.

DATA CONCERNING PLATINUM.

A VERY interesting pamphlet on platinum has been issued under the above title by Baker & Co., of 408 to 414 New Jersey Railroad avenue, Newark, N. J. This old and well-known firm have had a long experience as gold, silver and platinum refiners, assayers and sweep smelters, and of late years a portion of their large trade has been done in the electrical field, where platinum has been found to be indispensable for a great variety of purposes, both in the industrial arts and for laboratory use. Without platinum, it might be said, the modern incandescent lamp could not have existed, and Baker & Co. for many years have been active in supplying the demands of the lamp factories. But there are many other uses, such as in electric gas lighting, electro-medical apparatus, electrodes, contact points, etc., and platinum is needed for them in various shapes beyond the wire or sheet that are generally familiar. The pamphlet before us enumerates several of these employments of the metal, as well as of iridium, palladium osmium and other of the rarer metals of which in the advances that electricity is making, more and more use will be seen. A number of valuable tables, which we do not remember to have seen before, are also given as to the weight and capacity of platinum articles: the Troy and French weights per foot of platinum wire; the weight per square inch of platinum sheet or foil; a comparison of Troy, avoirdupois and French weights, etc. Several of these tables are copyrighted by the firm, and should prove extremely helpful to all who are interested. The back of the pamphlet gives a good picture of the Baker works at Newark, where this industry has been built up and has become a standard concern, enjoying a remarkably wide range of trade and custom, and growing yearly in magnitude and importance.

Inventors' Record.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED AUG. 23, 1892.

Alarms and Signals :—

Train Indicator, H. L. Manton, 481,364. Filed Dec. 1, 1891.

Employs a dial having a series of holes at different distances from its axis and a series of spring retracted plugs adapted to enter into said holes.

Pneumatic Electric Circuit Controlling and Interlocking Apparatus, W. W. Slater and H. C. Barnes, 481,430. Filed Oct. 24, 1891.

Employs pneumatic devices to take the place of the underground wiring in railway signal service.

Conductors, Conduits and Insulators :—

Insulator, A. J. Wylie, 481,457. Filed Jan. 18, 1892.

Employs a non-conducting bracket having a rounded out-standing portion with a longitudinal wire chamber extending entirely through it, and longitudinally disposed slots extending in a straight line through the face and opening into the wire chamber.

Dynamos and Motors:—

Electric Motor and Generator, C. S. Bradley and James J. Wood, 481,220. Filed Aug. 22, 1891.

Comprises a laminated core, the side plates having their polar projections bent over the end of the magnetizing coils to hold them in position.

Heating:—

Electric Water Heater, T. Ahearn, 481,291. Filed April 9, 1892.

Lamps and Appurtenances :

Shade for Incandescent Electric Lamps, C. J. Salick and E. Sipp. Filed April 10, 1891.

Reflecting Shade for Incandescent Electric Lamps, L. T. Stanley, 481,288. Filed Oct. 22, 1891.

Reflecting Shade for Incandescent Electric Lamps, L. T. Stanley, 481,378. Filed Feb. 29, 1892.

Miscellaneous :—

Circuit Changing Apparatus, A. D. Page, 481,281. Filed May 14, 1892.

Employs a rotatable body having a conducting section, and contact devices adapted to bear thereon, and adjustable with respect to one another.

Mast Arm, A. Wright, 491,381. Filed Oct. 14, 1891.

Electric Elevator, W. Baxter, J., 481,386. Filed Oct. 31, 1890.

An arrangement of circuits connected with a switch upon the elevator through the medium of a flexible cable, the construction being adapted to currents of constant strength.

Life Saving and Pleasure Craft, A. B. Shearer, 481,427. Filed March 29, 1892.

An electrically propelled life raft.

Magnetic Separator, G. Conkling, 481,474. Filed July 23, 1891.

Railways and Appliances :—

Trolley for Electric Railways, W. F. Jenkins, 481,401. Filed Sept. 5, 1891.

Provides means for separating and insulating from each other the wheels making contact with the two conductor wires in a conduit railway system.

Trolley for Electric Railway Conduits, W. F. Jenkins, 481,402. Filed Sept. 5, 1891.

Provides means for so adjusting the trolley to the car that the connection may be readily made, and the vertical and lateral vibration between car and trolley automatically taken care of.

Conduits for Electric Railways, W. F. Jenkins, 481,403. Filed Sept. 5, 1891.

Employs a conductor support having a collar and a screw nut and insulated clamping jaws arranged between them to hold the conductor.

Trolley Switch, J. S. Merkins, 481,503. Filed Oct. 17, 1891.

An automatic device whereby the trolley may be guided to the branch conductor while moving in one direction, and keep the main line conductor while moving in the opposite direction.

Trolley Protector, J. Walsh, 481,517. Filed Dec. 23, 1891.

Employs a mechanism by means of which the trolley pole is automatically drawn down the moment it becomes accidentally disengaged from the trolley wire.

Switches and Cut-Outs :—

Thermal Cut-Out, A. P. Seymour, 481,246. Filed Mar. 21, 1892.

Has for its object a cut out or similar device made of porcelain and moulded in a single piece.

Electric Switch, J. H. Clark, 481,297. Filed Sept. 29, 1891.

Employs a freely suspended weight, a connection between it and the movable member of the switch and a movable pulling point between them through which the connection acts.

Telegraphs:—

Ship's Telegraph, A. B. W. H. Cords, 481,223. Filed Jan. 14, 1892.

Employs a transmitting lever operating a pointer of the receiving instrument and a set of supplementary recording levers.

Telegraphy, J. G. Smith, 481,247. Filed Nov. 2, 1889.

A system by which any one of a number of persons may establish communication with any one other person at a distance with the same privacy that can be secured by means of a private line; the device requiring no hand manipulation except on the part of the persons using the wire.

Telephones and Apparatus :—

Plug Spring-Jack, C. A. Shea, 481,204. Filed April 23, 1892.

Consists of two engaging circuit breaking devices each comprising a plug, a circuit breaker and a holder for an additional circuit breaker and a flexible conductor connecting the insulating contact points of the two devices.

Telephone, A. Rettig, 481,284. Filed Feb. 17, 1892.

Employs several diaphragms varying in size and lever and spring devices connecting the diaphragms.

Arm Rest for Telephones, J. R. Bailey & L. C. Lincoln, 481,293. Filed Jan. 25, 1892.

Telephone System, R. N. Dyer, 481,483. Filed Oct. 30, 1890.

Has for its object to prevent disturbances and dangers arising from grounding the current supplying circuit through the telephone apparatus or line.

Telephony, J. W. Gibboney, 481,539. Filed Feb. 8, 1892.

Claim 10 follows:

The method of telephoning, consisting in passing over a circuit an alternating current or a current of changing value, passing said current through a coil of an inductorium and varying the counter-induction of said inductorium by the agency of sound vibrations.

Obituary.

F. N. GISBORNE.

The death is recorded at Ottawa, Can., on Aug. 30, of Mr. F. N. Gisborne, who was largely instrumental in the construction of the first Atlantic cable. He it was who first directed the attention of Mr. Cyrus Field to the project, and he first carried the land line across Newfoundland.

Mr. Gisborne was born in Broughton, Lancashire, England, March 8, 1824. In 1842 he started on a tour around the world which lasted nearly three years. He finally settled, in July, 1845, in Canada. But he was not long content with the life of a farmer. He had a keen interest in telegraphy, and in 1847 he deserted his farm for a place in the office of the Montreal Telegraph Company. Not long afterwards he opened the first office of the company in Quebec. He advanced rapidly, and in 1850 he was the chief officer of the Nova Scotia Telegraph Company.

It was at this time that he conceived the idea of a telegraph line to connect St. Johns, N. F., with the main continent. He figured that if St. Johns, the most easterly point in America, could be brought into electric connection with the mainland, news could be received forty-eight hours in advance from Europe over the system then in vogue. At this time Newfoundland was an unexplored wilderness. The project of erecting a telegraph line through this wild stretch of country, some 400 miles in length, was hazardous enough, but Gisborne carried his plans even further, it being his intention to ultimately run a submarine cable across the Gulf of St. Lawrence, as was subsequently done. As soon as his plan took definite shape he appeared before the Newfoundland Legislature and succeeded in obtaining a grant of £500 for a preliminary survey. Resigning his office with the Nova Scotia Telegraph Company, he obtained land grants and organized the Newfoundland Electric Telegraph Company. Then he set out upon the survey, which lasted three months.

He finished the survey in spite of tremendous difficulties, and after making a favorable report on the project he came to New York to obtain financial aid. He succeeded in interesting capital in this city. In 1852 he laid the first submarine cable of any length put down in America, from Cape Ray to Prince Edward Island.

In 1853 his backers in New York deserted him, and he found himself hopelessly involved in a project which he had not the means to carry out. He was even arrested and imprisoned for the debts contracted by the company, and only succeeded in regaining his liberty when he had sacrificed every dollar he had in the world. But he still clung to his project, and in 1854 he returned to New York to renew his efforts.

It was at this time that he met Matthew D. Field, a brother of Cyrus W., who was a civil engineer and a railroad builder. Through him he was introduced to Cyrus W. Field. From this grew the work which finally ended in the Atlantic cable being laid. Mr. Gisborne took an active part in the undertaking, and it was under his charter that the Transatlantic Telegraph Company first began operations.

After the cable was finally laid, Mr. Gisborne was appointed superintendent of the Dominion Government Telegraph and Signal Service, an office that he held until his death. He was the inventor of a number of valuable electric appliances, and also produced inventions in other lines. He was one of the original members of the Royal Society of Canada.

JOHN K. DUNBAR.

The death is announced of Mr. John K. Dunbar, at Buffalo Lithia Springs, Va., on August 16. He had been connected with the Southwestern Telephone and Telegraph Co. since its formation in 1881, and at the time of his death was its general superintendent. His illness was primarily due to the grip, and had lasted several months. Mr. Dunbar was popular among his associates and the employees of the company, being kindly and generous of nature. He leaves a widow and two daughters.

ENDOLITHIC PRINTING ON IVORY.

We have received from the Endolithic Ivory Co., Limited, 61½ Fore street, London, England, a sample of their endolithic printing on ivory. The process is one which, it is said, renders the printing indelible in any climate, and is available for switchboards, keyboards, speaking tubes, apparatus, name plates, etc. In England it is used by the Brush Co., Laing, Wharton & Down; B. Verity & Sons; Siemens & Halske; Spagnoletti & Crookes; the National and Consolidated Telephone Companies and others. The switchboard tablets are made in sets as required. The sample before us is a very neat and pretty piece of work that looks as though it would stand wear.

TRADE NOTES AND NOVELTIES

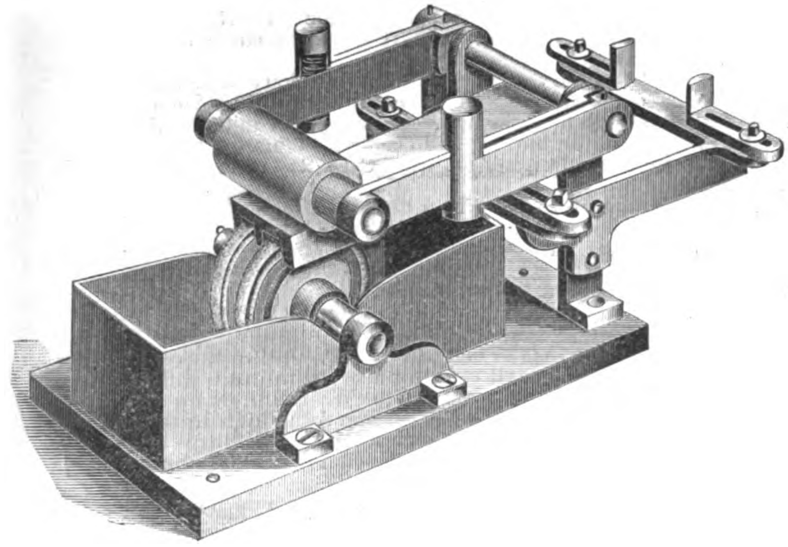
AND MECHANICAL DEPARTMENT.

Let your advertisement be readable without the aid of a magnifying glass, but don't expect large type to take the place of merit in your goods.

THE STANDARD PAINT CO.'S MACHINE FOR PAINTING ELECTRIC MOLDINGS.

The Standard Paint Co., of 2 Liberty street, the sole manufacturers of the P. & B. compounds, etc., have recently put in the market a small machine for painting molding. As almost all molding for inside wiring is now required to be painted with a waterproof compound, they have concluded that it would be to the advantage of those who have this work to do, to use such a machine. It affords a great saving in labor, and a considerable economy in the use of the paint or compound. This painting machine is very simple, as shown by the cut. It can be so arranged that any size molding can be painted by it. Any one can handle it, and two boys can easily paint 1,000 feet of ordinary size molding, inside, outside, and back of capping within an hour.

The machine does its work thoroughly. It does not take up any room to speak of, and is strongly built as well as cheap. The machines are already much used in connection with the P. & B. water and acid proof compound, and are giving very great satisfaction.



Machine for Painting Moldings.

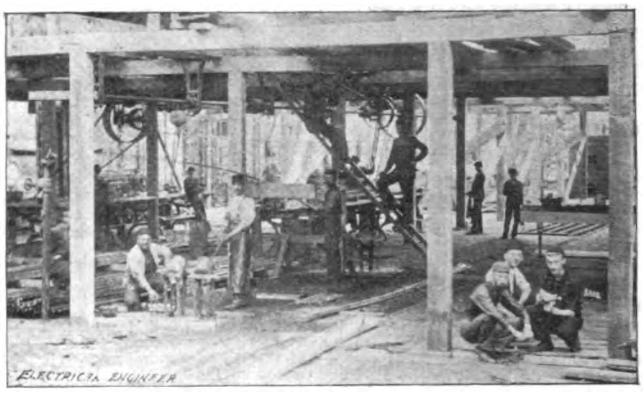
It will be remembered that in most of the large cities the boards of fire underwriters require all moldings through which electric wires run to be coated inside and out with insulating compound. Without such a machine as this, the painting of moldings, necessarily by hand, is slow, tedious and expensive work.

LOW TENSION LIGHTS FOR FIFTH AVENUE, NEW YORK.

Fifth avenue, which, for the past year, has been but feebly illuminated at night by the old-fashioned gas lamps, will soon be lighted by a new and improved system of electric lighting, the contract for which has been made with the Edison Company by the Gas Commission. A new style of electric arc lamp, designed for use on low tension incandescent circuits, will be used. The lamp is the invention of Mr. Sigmund Bergmann, president of the New York Electric Equipment Company. Fifty poles will be erected at intersecting streets from Washington Park to Fifty-ninth street, and on each of the poles will be two of the new lamps. Contracts for the manufacture of the poles, which are to be of cast iron, about twenty feet high, have been made. They will be ornamental, as will also the lamps with which they will be surmounted. These will have artistic brass finishings and ground glass globes of special design. There will be no overhead wires, the cable being introduced from the Edison Company's subway. The hollow of the pole contains a counterpoise, by which the lamps may be lowered for trimming or repairs. The lamps on each pole are independent of those on every other pole, being in multiple to the mains. The lamps can be controlled either from the central station or at the base of the pole, which is fitted with a locked door, the key to which is kept by the illuminating company's officials. These lamps are to be paid for at the rate of 50 cents a night for the pair.

ELECTRIC MOTORS AND THE SCHENECTADY FIRE.

A bad fire occurred in the underground tube department of the General Electric Co., at Schenectady on July 25, razing the building to the ground, with a loss of about $52,000, covered by insurance. The fire appears to have been due to spontaneous combustion, as it flashed up suddenly about 7.30 a. m. while a barrel of kerosene was being rolled through the shop. The weather had been extremely hot, greatly favoring an explosion such as occurred. Some idea of the promptness with which the works and its fire department grappled with the fire may be formed from the fact that it has at work within a few minutes, while a number of photographs were secured within 15 minutes after the flames were seen. One of the accompanying illustrations is from a photograph taken after the fire.



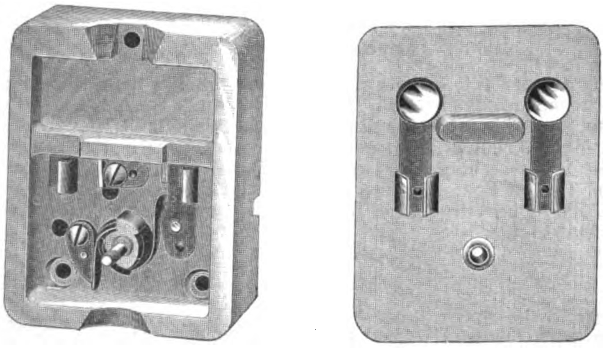
Edison Tube Works Before the Fire.

But the special interest attaching to the fire is due to the prompitude with which work was resumed with the aid of electric motors. Large supplies of the Edison tube were needed for New York, San Francisco and other cities, but the tube shop would have stood idle for a long time, had it waited for steam power. As it was, everything was in full swing the following week, in a practically new factory, the power being supplied by electric motors, to which, of course, the wires were easily run from the big power station. The extensive use of electric motors at Schenectady was described in The Electrical Engineer, and this experience is but another demonstration of the great ability of the electric motor.

Edison Tube Works After the Fire.

THE GENERAL ELECTRIC CO.'S COMBINED SWITCH AND FUSE BOX FOR RAILWAY LIGHTING CIRCUITS.

THE accompanying illustrations show a very neat combination switch and fuse box for use on the lamp circuits of electric street railways cars, recently introduced by the General Electric Co.



FIGS. 1 AND 2.—GENERAL ELECTRIC CO.'S SWITCH AND FUSE BOX.

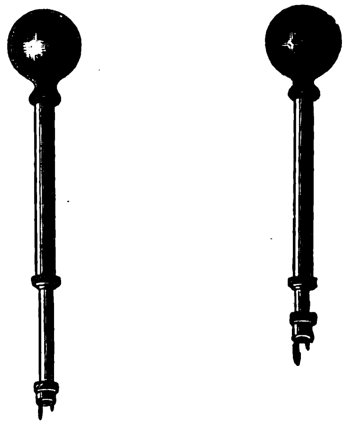
Fig. 1 shows the body of the box with the rotating ratchet switch in the lower compartment, and Fig. 2 the reverse side of the cover with the terminals and thumb screws for the metal fuse.

This box is claimed to possess many advantages over anything heretofore in use for railway lighting service. It is very compact, neat, and, as it is made entirely of porcelain, perfectly incombustible. The switch is of the latest improved type of rotating ratchet switch manufactured by the General Electric Co. and possesses the essential points of good contact and sudden break. The fuse is placed on the inside of the cover, so that in replacing a blown-out fuse the terminals are taken completely out of the circuit, and it is utterly impossible to receive a shock in any way. The brass clips on the cover fit over the two contact posts in the box, and serve the double purpose of holding the cover in place and forming part of the circuit.

As will be seen in Fig. 1, the box is divided into two parts, the lower holding the switch and the terminals for the wire, and the upper part consisting of a shallow recess into which the thumb screws on the inside of the cover project. In the back of the box behind this upper recess is a magnetic blow-out, which breaks the arc formed when the fuse is blown. In general appearance the box is quite ornamental, and with its great superiority over other and older devices for the same purpose it should commend itself strongly to all street railway men.

THE DANDY DOUBLE-POINT TACK DRIVER.

THE "Dandy Double-Point Tack Driver" is illustrated herewith. Fig. 1. shows the tool at rest with a double-pointed tack protruding from the end.



FIGS. 1 AND 2.—DANDY DOUBLE-POINT TACK DRIVER.

Fig. 2 shows the action of the tool in the position of having driven the tack in place. This little tool is useful in driving double-pointed tacks into corners and places where an ordinary hammer cannot be employed. It effects a great saving of labor, the use of the tool permitting the wireman to facilitate his work very materially. Telephone companies and other large wiring companies who use double pointed tacks, should find it very convenient.

Applications have been made for a patent, and the Central Electric Company, Chicago, are putting it on the market.

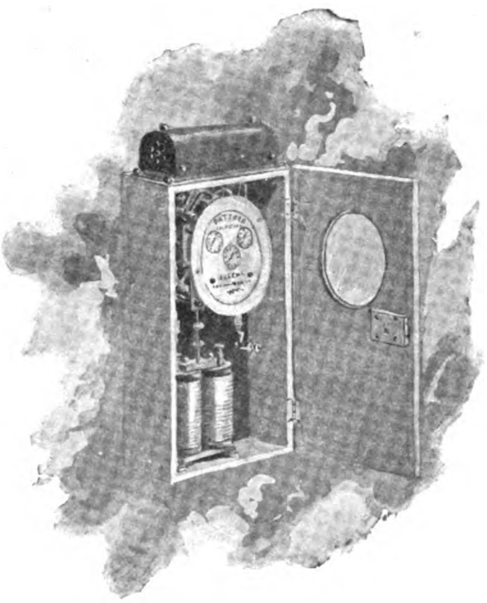
THE PURITY OIL FILTER MANUFACTURING CO.

THE above company of Pittsburgh, Pa., report the following shipments in July to the 15th ult.: Vacuum Oil Co., New York City; San Francisco and San Mateo Electric Railway, San Francisco, Cal.; Marshall Kennedy & Co. Flour Mills, Allegheny Pa.; Homestake Mining Co. Lead City, South Dakota; Black Hills Mining Co., Rapid City, South Dakota; Tennessee Manufacturing Co. and Union Mill Co. one No. 2 Ideal each, Nashville, Tenn.; Thomson-Houston International Co., for export to England; House of Refuge, Glen Mills, Pa.; E. H. Kellogg & Co. two No. 2 Purity Oil Filters, New York. The company cannot get any stock ahead with their present force, but intend to double their capacity.

PATTEE'S LAMP-HOUR RECORDER.

GEORGE CUTTER is putting out a new form of the Pattee lamp-hour recorder which is already used by a number of Western stations. It is well adapted for use with arc lamps or series incandescents, and thus fills a long-felt want. The illustration shows one designed for use with a motor working on a steady load, the charges for current being in direct proportion to the running hours.

For arc lamps, the use of this device leaves the consumer free to burn his lamps early and late, and still gives the central station an exact record of the current used. The new form has recently been patented and is supplied to the trade by George Cutter of Chicago.



PATTEE'S LAMP-HOUR RECORDER.

ELECTRIC LIGHT EXHAUST STEAM FOR HEATING PURPOSES.

THE ELECTRIC LIGHT AND POWER COMPANY, of Grinnell, Iowa, is laying a line of protected underground steam pipe through which to circulate its exhaust steam for heating purposes. The work and material is being furnished by the American District Steam Company, of Lockport, N. Y. At St. Joseph, Mo., Canton, Ohio, and several other places, electric companies are preparing to build exhaust steam plants the present season.

OCEAN LIGHT SHIPS.

THE London *Telegraph's* Paris correspondent says: "The French Transatlantic Company takes up again the project relative to ocean lights which was dropped a few years ago. The proposal is that light ships connected by telegraph cables be stationed at intervals of 200 miles across the Atlantic."

ENTERPRISE ELECTRIC CO.

THE branch house of this company has now been opened at 15 North 9th street, St. Louis, and Mr. W. H. Ferris, the manager, reports that the business is already brisk. The Chicago end of the line states that it feels elated, not having been affected by the hot weather lethargy that handicapped Western trade generally for a while.

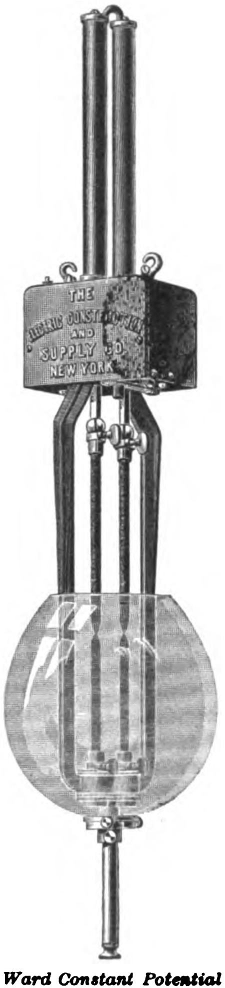
MR. C. D. SHAIN.

HAVING lately severed his connection with the Edison General Electric Co., for which he was the manager in the Eastern District, Mr. C. D. Shain has established himself as an electrical engineer and manufacturer's agent, with headquarters at 303 Electrical Exchange Building, 136 Liberty street, this city. While he is not yet prepared to make all his announcements, Mr. Shain has, it may be stated, become selling agent for the Western Electrical Instrument Co., in which capacity he will attend to the large trade already built up in the well-known Weston voltmeters, ammeters, etc.

THE WARD CONSTANT POTENTIAL ARC LAMP FOR STREET LIGHTING.

IT is the opinion of many observers that the day has come for the extensive use of low tension arc lamps for street lighting, enabling companies to combat the strong prejudice that exists against high tension series lamps, and also to avoid the stringing of wires, as the low tension lamps are run in multiple on the regular incandescent circuits. These circuits are generally underground in large cities; and even when overhead, the fact that they carry only a low, safe potential disarms criticism. Constant potential arc lamps, run in multiple and multiple series across the incandescent mains of isolated plants and local companies, are now counted by their thousands, and it has come to be only a question of time when they would be used for a whole street, under contract, like the familiar series arcs.

The Electric Construction & Supply Co., of 16 and 18 Cortlandt street, the makers of the celebrated "Ward" constant potential arc lamps, have been keen students of the situation, which, in fact, they have done much to create; and they are now putting on the market a "twin lamp," intended for regular municipal street work, and with which very successful results have been obtained during the past eighteen months. This "twin lamp" is of the appearance shown by the cut, being practically indistinguishable from a double lamp. It has two independent regulating mechanisms and two corresponding magnet systems in continuous operative connection with the supply circuit. The lamp thus constructed and run on a 110-volt circuit will pass 4 or 5 amperes through each of its two sets of carbons constantly burning in series to each other, in the one frame. This gives at least as much light as, and probably much more than, a single 8 or 10 ampere lamp, and hence can be used as an economical and unusually satisfactory substitute for a single lamp giving the standard illumination, since the two arcs use up substantially the whole voltage and wasteful resistance is unnecessary. It is obvious also that, for the current consumed, the distribution of the light is much better and much more effective. Evidently there is a very large field for such a lamp as this.



Ward Constant Potential Arc Lamp for Street Lighting.

FINANCIAL.

NEW THOMSON-HOUSTON BONDS.—The Thomson-Houston Electric Company has issued $500,000 collateral trust thirty-year 5 per cent. gold bonds due July, 1919, and secured by $600,000 Manhattan Electric Light Company of New York first mortgage thirty-year 5 per cent. gold bonds. The bonds are redeemable after 1899 at 105 and interest.

ABNORMAL LAMP BREAKAGE.

WHO broke that electric light on the west side? It is rumored that certain young people who are ashamed to do courting in a hammock under the glare of electricity are responsible for the deed. They had better look out.—*Manson, Ia., Democrat.*

THE NEW ORLEANS ELECTRIC ROAD.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., will design and construct the new buildings for the New Orleans and Carrollton Railroad Co. The power house is 83 x 130 feet, with brick walls and an iron roof. The car shed will be built entirely of iron 130 x 140 feet. It is the intention of the New Orleans and Carrollton Railway Co. to have the finest electric railroad plant in the Southern States.

PEPPER & REGISTER.

THE above Philadelphia electrical engineering firm, who have the contract for the Easton, Pa., Rapid Transit Co., write us that it is to be a Westinghouse plant, with 20 cars of 40 h. p. each, and with Westinghouse multipolar generators, with steam power furnished from the present plant of the Edison Electric Illuminating Co., of Boston. Iron poles will be used, made by Milliken Bros.; Simplex wire and either the Johns or the Anderson overhead material.

OKONITE.

AMONG the many large buildings which have recently been wired with Okonite wire, the Central Electric Company report having secured the St. Charles Hotel, Chicago, which will be furnished with 1,100 lights, Okonite being used throughout. This insulation was decided upon, it is said, in the face of the fact that the prices were considerably higher than those of other grades of rubber wire.

ENTERPRISE ELECTRIC CO.

THE above company, of 313 to 315 Dearborn street, Chicago, has elected Mr. Geo. Dickinson as its secretary. He has had extensive experience and will prove a valuable acquisition. Mr. W. C. McKinlock, the president, has been in St. Louis, studying the development of the business there.

NEW ENGLAND NOTES.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., are putting up two iron buildings for the Randolph & Clowes Co., at Waterbury, Conn. One is a casting shop 42 feet wide by 82 feet long, and the other a pickle-room 25 feet wide by 100 feet long. The Berlin Company are also building a new gas house for the Philadelphia & Reading R. R., at Philadelphia, Pa., a new retort house for the Geo. H. Morrill Co., of Boston, Mass., and a new boiler house for the Pope Manufacturing Co., of Hartford, Conn. All of these buildings are to be of iron, after the well known plans of the Berlin Company.

NEW ORLEANS NOTES.

MR. WILLIAM OSWALD, the manager of the Southern Electrical Manufacturing and Supply Company, Limited, of New Orleans, Louisiana, has closed the following contracts: Elm Hall Plantation, 450 incandescent and 4 arc lights, with New York Safety Steam Power Company's engine; Cora Plantation, 360 incandescent and 4 arc lights, with engine; Morbihan Plantation, 250 incandescent lights, with engine; Albania Plantation, 150 incandescent and 2 arc lights, with engine.

PHILADELPHIA NOTES.

FRANCIS & NARDI announce that they have associated with them Mr. Elmer P. Strang, late with the Novelty Electric Co., and Mr. Myer S. Levy; and that they will continue their business of electrical engineering and construction at their new offices in the Haseltine Building, 1418 Chestnut street. The new firm name will be Francis, Nardi, Strang & Co.

WESTERN NOTES.

THE SCHUTTLER RATCHET DRILL.—The Electric Appliance Company are placing upon the market a device which promises to become very popular among electrical and street railways generally. It is known as the Schuttler ratchet drill. It is a new track drill, its special feature being that a continuous rotary motion is produced by a powerful ratchet action, making it, the claim is, the most powerful and rapid track drill on the market. It is sold at a price which is also an attraction.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

VOL. XIV. SEPTEMBER 14, 1892. No. 228.

A BIOGRAPHICAL REVIEW OF THE KHOTINSKY ACCUMULATOR.—I.

BY

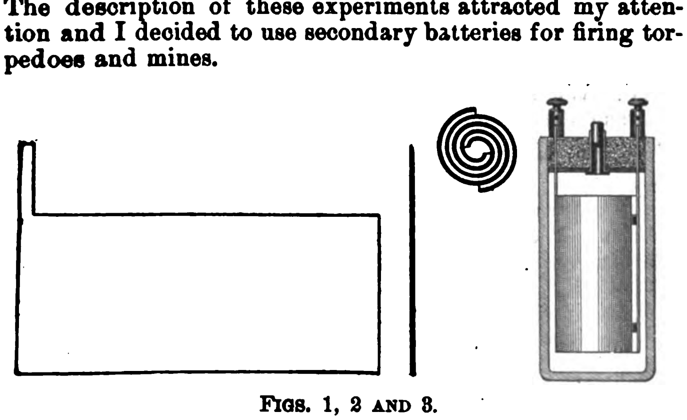
Capt. A. de Khotinsky

DURING the year 1871, when I was flag officer of Commander Admiral Butakoff, I was appointed to take charge of the electric lighting, also experimenting with torpedoes in the iron-clad squadron of the Russian-Baltic fleet.

In the summer of 1871 platinum primers were used to explode mines, this being accomplished by electrically heating the platinum breech by means of a large surfaced Grénet battery cell of small internal resistance. The cells were composed of three fixed carbon plates and two movable zinc plates. These cells fulfilled their purpose fairly well during a calm sea, but in rough weather they soon got out of order. It was unsafe to let the zinc plates of these cells remain in the fluid because the local action of the chromic acid on zinc polarized the cell, and, therefore, at the decisive moment, when most wanted, the battery failed to do its work.

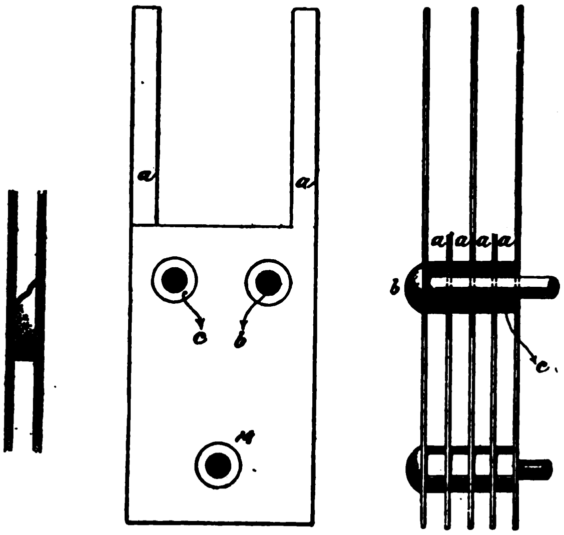
To prevent this, particular care was taken to have the zinc plates first touch the fluid just before the decisive moment. The result was, however, that very frequently in this way the explosion entirely failed or followed too late, while under the prevailing excitement either the sinking of the zinc plates in the fluid was overlooked or the movable contact failed because the connecting rods, by contact with the swaying acid, had oxidized. By this occurrence it was proved that with Grénet cells of the construction used in 1871, it was impossible to be sure of effecting an explosion at a desired moment.

About this time I read in the scientific papers of the experiments of M. Gaston Planté with secondary batteries. The description of these experiments attracted my attention and I decided to use secondary batteries for firing torpedoes and mines.



FIGS. 1, 2 AND 3.

For this purpose I constructed, in the winter of 1872, cells exactly in accordance with the idea of M. Planté, as shown in Figs. 1 and 2. I rolled together in a spiral shape lead plates 1 mm. thick, 80 mm. broad, 180 mm. long with intervening layers of two rubber strips $2\frac{1}{2}$ mm. in thickness and the same in breadth and put these rolls in a glass vessel filled with 10 per cent. sulphuric acid, Fig. 3. I formed these secondary cells with a battery of four Daniell cells by frequently changing polarity as Planté prescribed.



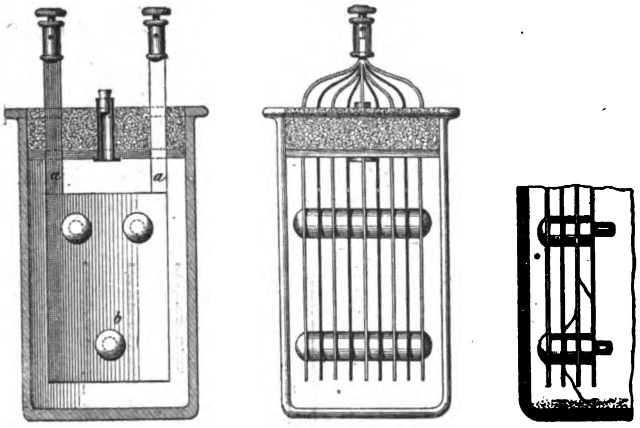
FIGS. 4, 5 AND 6.

After taking a month to form these cells, I began to experiment with them in order to fire a common platinum primer. This experiment gave much better results as compared with the Grénet elements. I carefully charged two of them and traveled from St. Petersburg to Kronstadt (35 kilometres) to show that an explosion could be produced by one pocket secondary cell. But, unfortunately, the experiment did not succeed, because in neither of the cells was there any charge remaining. This misfortune compelled me to carefully study the peculiarities and existing deficiencies of secondary batteries.

Returning to St. Petersburg, I began to examine the surface of the elements and then discovered that the positive plate in several places had become corroded and the whole surface was of a brownish yellow color which proved to me that the battery was entirely discharged. The further proof of the discharge was that the negative plate had assumed a bluish gray instead of a light gray color.

On removing the plates I found on the bottom of the vessel a sediment of light yellow powder mixed with dark brown scales, and after unrolling the plates I found that the same yellow powder had settled on the insulating strips and covered them with yellow scales. Some of these were larger than the distance between the positive and negative plates, as shown in Fig. 4. By measuring the resistance of the scales and the powder, it appeared that both materials were conductors, but the scales better conductors than the powder.

These experiments proved that my secondary battery by discharging itself during the journey from St. Petersburg to Kronstadt had lost its charge and that this discharging must have resulted from short-circuiting brought about by parts of the positive plates that had fallen off in the journey. This showed to me that it was impossible to make a rational element in accordance with the specifications of M. Planté and I discontinued further investigation of secondary batteries till I should have more time at my disposal. I then spent all the time I had on further experiments with incandescent lamps, which I had already begun in August, 1871, when I was interrupted by the before-mentioned experiments with secondary batteries.



FIGS. 7, 8 AND 9.

In the spring of 1874 I received a commission from Admiral Possiet, Minister of Commerce in St. Petersburg, to take part in a commission for lighting the harbor at Odessa, under the presidency of General Agustinovitch. One of the problems for the commission was to find the best way to light and extinguish the signal lights at the entrance of the harbor from a distance of about half a mile; these were gas lights. The solution of this problem was given to me.

Here again was a chance for me to deal with secondary batteries, for I thought I should find the most direct and best solution of the problem if I could light the gas in the signal lights by glowing platinum and bringing it to a glow by means of the electric current. This is not the place to describe the whole apparatus, which I used to turn on and off and light the gas, but I turn directly to the description of the secondary batteries, which I made and used to fulfil my purpose.

I knew from previous experience that the use of rubber strips over the whole length of the plate was the reason for the short-circuit of the plates. After trying many devices to avoid this drawback I decided upon the following construction: I cut the lead plates 1 mm. thick, 45 mm. broad, 56 mm. in height, with a contact prolongation on one side, as shown in Fig. 5. Every plate had three holes for the purpose of connecting nine plates to make one element, shown in Fig. 6. Hard rubber pins *b* were put through the plates *a* to hold them in rows, and at the holes each plate was insulated from the next by soft rubber washers, *c*. By this arrangement I thought that the peroxide would be free to fall on the bottom of the vessel without lodging on the insulation. I left, therefore, a space of 1½ cm. at the bottoms. Figs. 7 and 8.

This element, produced in the summer of 1874, as described, worked well at first to light gas, and also when used for the explosion of torpedoes. After working all summer they showed in the fall that if they were charged and left for one day on open circuit then they gave no current on the following day. On closer examination of this element I found no longer, as before, only small scales, but whole layers of peroxide loosened from the surface of the positive plates, see Fig. 9. I cleaned the element entirely of these scales and commenced again to charge, but the result reached was poor.

Instead of being able to light 60 to 80 times with the fully charged elements, the capacity now was only from 8 to 10 times. I thereupon again took a very long time in charging it, but the whole surface of the positive plate loosened and fell off, while the plate itself commenced to warp in all directions. The whole element looked as if it had been made of lead and was going to be formed anew.

My service duties did not allow me after these disappointments to further occupy myself with secondary batteries. In the beginning of 1878, during the Russo-Turkish war, I was commanded by the Russian Marine Ministry to build cruising ships in America for the Government. Returning from America in 1879 I was employed by my chief, General Admiral Grand Duke Constantine, as chief engineer in the Jablochkoff Company, and was again prevented from occupying myself with secondary batteries. At that time I continued my experiments with good results in oxy-hydrogen illumination, which was based on the cheap production of oxygen. I found capital for working up this patent, which is still in force, and resigned from service in the Russian navy.

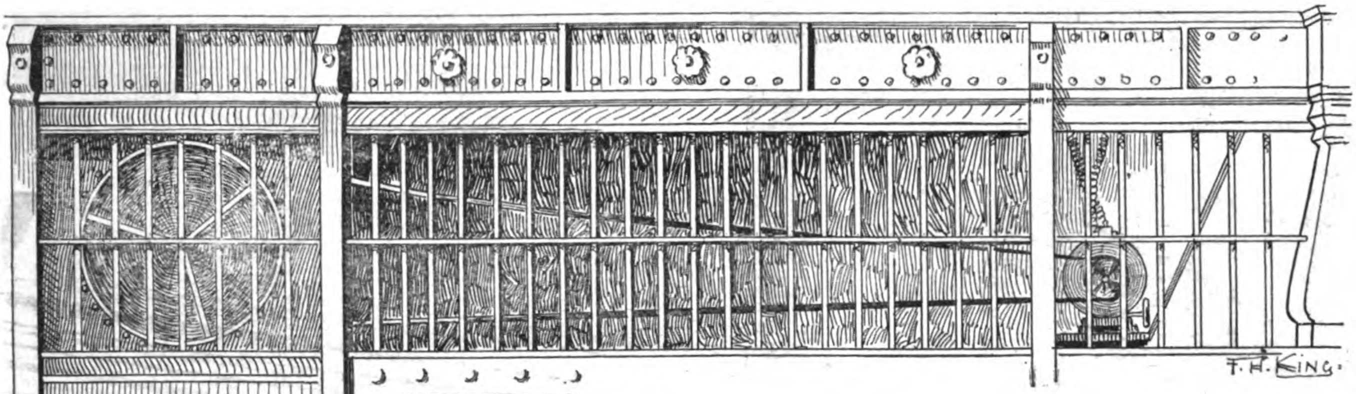
Mr. N. de Kabath, founder and owner of the journal *l' Electricien* in Paris, had in St. Petersburg seen my oxy-hydrogen light and saw the prospect for making money out of my patent in Paris. I therefore went to Paris early in the year 1880 supplied with all necessary apparatus and established there an experimental station in the bureau of the Compagnie des Horloges Pneumatiques, Système Popp. There was plenty of time left at my disposal, and I called on Mr. Kabath to get permission to make further experiments with accumulators in the laboratory of the journal *l' Electricien.* This permission was given to me, and the work in this laboratory was the more interesting as I there made the acquaintance with M. Hospitalier, editor-in-chief of *l' Electricien* and a man of considerable learning. I had, besides this, opportunity for almost daily intercourse with Messrs. Gaston Planté, Niaudet and Tissandier.

ROTARY STATIC DISCHARGES.

THE interesting article by Dr. William James Morton, on "The Nature of Electric Currents," published in THE ELECTRICAL ENGINEER of July 20, ult., has led to considerable discussion in regard to the twisting, or helical, motion of a spark shown by its passage through a number of sheets of paper. A photograph of an actual discharge, which in this case was a lightning flash, has been sent us by Mr. T. H. Bailey, of Haverhill, Mass., which seems to show this twist very clearly. The accompanying illustration is reproduced directly from Mr. Bailey's photograph, taken about the time that Dr. Morton's article appeared. We regret that the engraving of this photograph is not as clear as could be desired, but the twist is discernible in the original.

ELECTRIC BOATS ON THE SEINE.

MESSRS. WOODHOUSE & RAWSON have just launched upon the Seine, at Asnières, an electric boat, *L'Eclair*. Its first trip was made on August 9th, in the presence of the Parisian electrical press. This boat is 37 feet long, 5 feet 10 inches wide, and has a draught of 16 inches. It contains two batteries of 20 accumulators of 160 ampere-hours, and a 3 h. p. motor. The accumulators are all connected in series (80 volts, 30 amperes), for the express speed of 8 miles an hour. They are connected in quantity for lower speeds. The boat is constructed to hold 20 persons. The charging is effected at the accumulator station at St. Ouen.



A DAY WITH EXCELSIOR MOTORS IN NEW YORK CITY.

BY

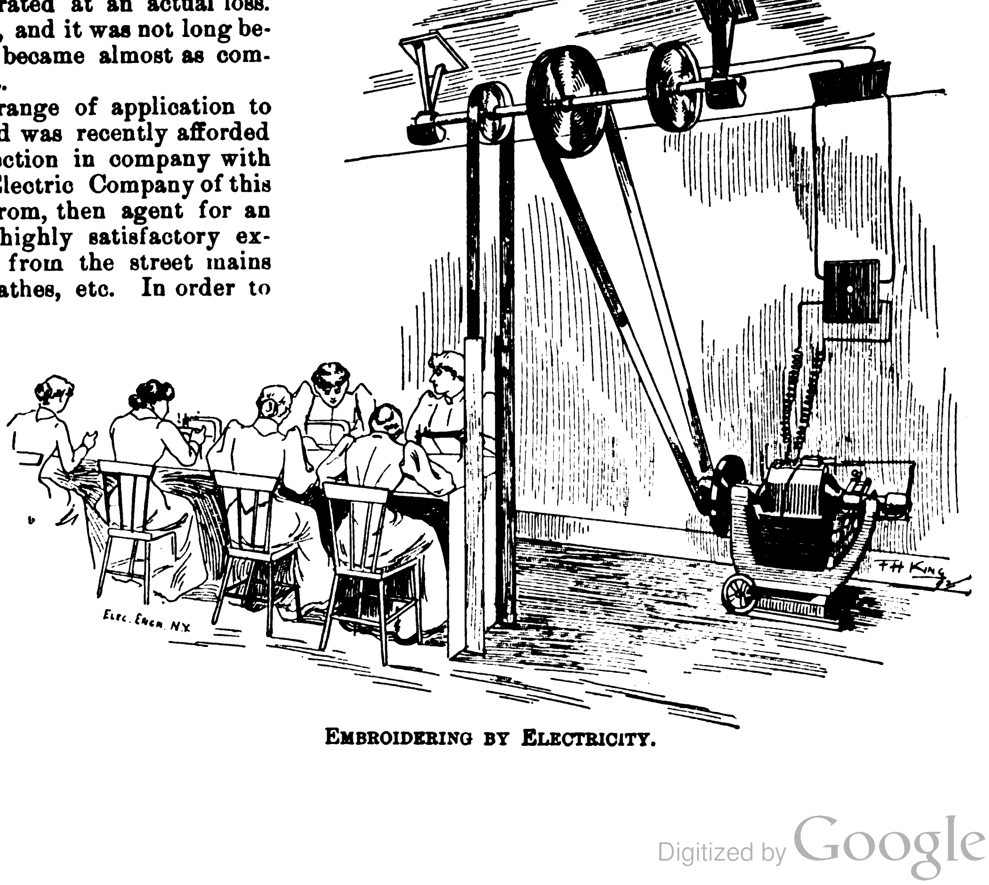
George Barton Muldaur

ALTHOUGH the use of electricity for the transmission of power is of such recent date, the fact has already become permanently established, even in the public mind—and the public is not over quick in such matters—that in regard to cheapness, cleanliness, compactness, and freedom from noise the electric motor of to-day stands without a rival in very many departments of labor. Especially is this true where power is to be applied at a distance from its source of generation, or subdivided into a number of independent units; and also where used only at such short intervals that the expense of maintaining a steam plant would amount to foolish extravagance.

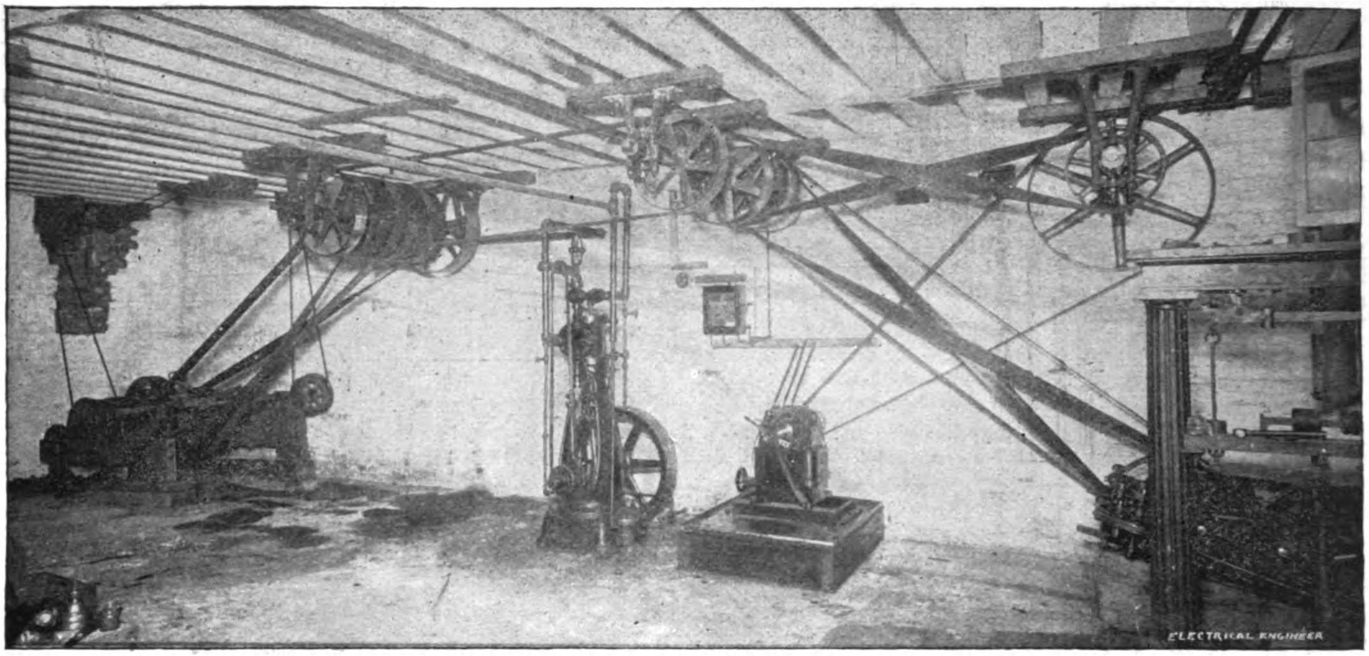
When the electrical illumination of cities and towns became general the question of how to best utilize steadily through the day the machinery at the central station in order to reduce the cost of lights while realizing a fair profit on the capital invested began to assume formidable proportions, as the part of the plant kept running during daylight hours was frequently operated at an actual loss. A demand usually creates a supply, and it was not long before the sale of current for power became almost as common as the sale of current for light.

A striking instance of the wide range of application to which the electric motor is adapted was recently afforded me during a short round of inspection in company with Mr. J. L. Krom of the Excelsior Electric Company of this city. Not many years ago Mr. Krom, then agent for an engine company, installed many highly satisfactory examples of his wares, taking steam from the street mains and operating elevators, pumps, lathes, etc. In order to keep up with the march of progress, he is now busily engaged in replacing engines, with electric motors, which give better results at a considerably less cost.

A model plant of this kind is that in the basement of Messrs. Callahan & Kemp, dealers in groceries and teas at 41 and 43 Vesey street. Here are three elevators, two running to the top of the building and the other to the sidewalk. These have been operated from 1885 until quite recently by a vertical engine, with about seventy feet of shafting extending the entire width of the basement. The present arrangement is as follows: A 10 horse power Excelsior or Hochhausen 220-volt motor is set on a Georgia pine foundation lagged to the concrete floor, and occupies a space about three feet square between the sidewalk elevator and one of those running to the roof. The former is of the "A. B. C.," spur gear type, and carries an actual load of 2,500 pounds, while the latter is a Brigham & Webb lift of 3,000 pounds capacity. The motor is belted with a double leather belt to a main shaft, and thence to a countershaft from which power is transmitted by belts to both elevators. The wiring is done after the most approved methods and is encased in Interior Conduit metal tubing, while the specially arranged cut-out and starting switch are provided with a backing of asbestos. The Excelsior motor runs at 1,350 revolutions per minute, and is cool under the load of both elevators operating simultaneously at



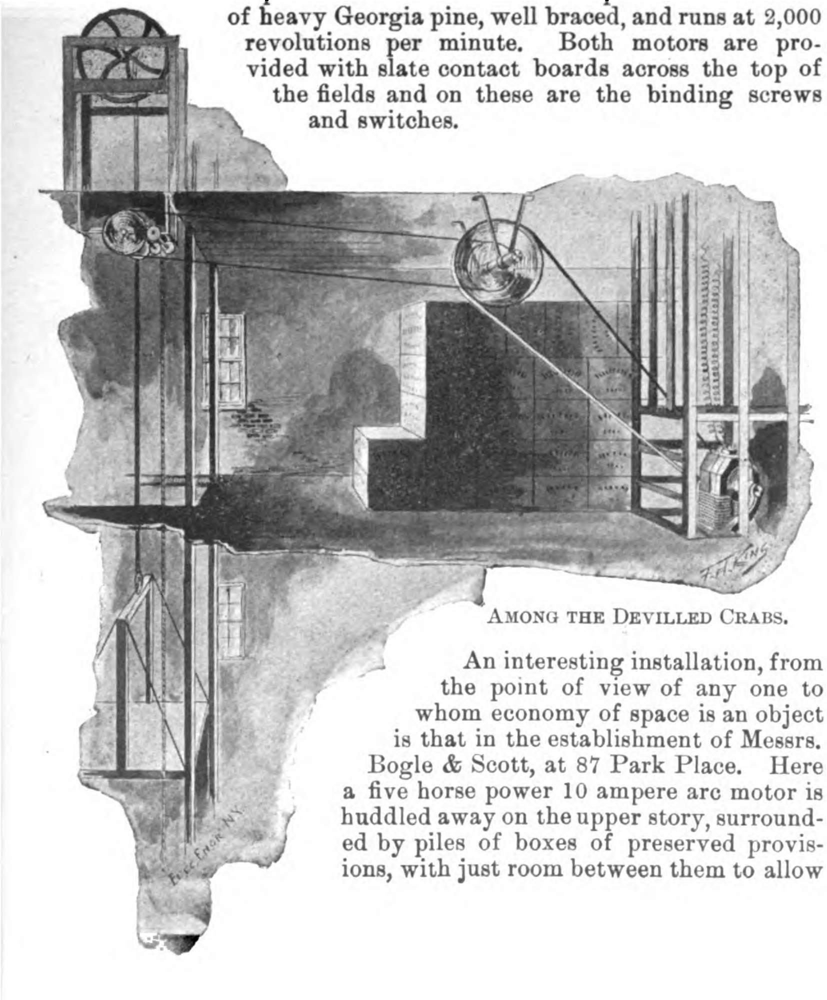
EMBROIDERING BY ELECTRICITY.



TEN HORSE POWER MOTOR RUNNING TWO ELEVATORS.—*From a photograph by flash light.*

their full capacity. It is provided with double brushes, and its sliding base permits the use of an endless belt. The constant hammering of the joint of an ordinary belt against the pulley, aside from the noise it makes, has the effect of jarring the motor and eventually of injuring the bearings, so that this feature of endless belts is one of considerable importance.

At the opposite side of the basement, about seventy feet away, is the other elevator running to the roof and having a capacity of 1,500 pounds, driven by a little two horse power Excelsior motor resembling the other in all respects except that of size. This stands upon a kind of table of heavy Georgia pine, well braced, and runs at 2,000 revolutions per minute. Both motors are provided with slate contact boards across the top of the fields and on these are the binding screws and switches.

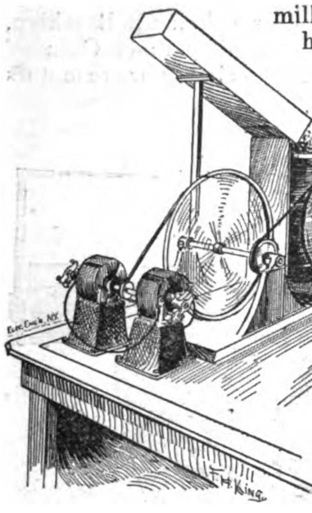


AMONG THE DEVILLED CRABS.

An interesting installation, from the point of view of any one to whom economy of space is an object is that in the establishment of Messrs. Bogle & Scott, at 87 Park Place. Here a five horse power 10 ampere arc motor is huddled away on the upper story, surrounded by piles of boxes of preserved provisions, with just room between them to allow the belt to run to the mechanism of the grip hoist, ten feet away. The whole floor space devoted to the motor is not more than one square yard and the passage way through which an attendant is supposed to pass sometimes, to clean and oil it, is too small to count and exists chiefly in imagination. The motor, on the day I saw it, was doing excellent work raising loads a height of four or five stories without a murmur; and it had probably not been touched, for months, except for the purpose of starting and stopping. The commutator was actually so caked with dirt as to show no metallic lustre whatever, yet the work went on regularly and every one seemed perfectly satisfied. The man in charge said he had not time to clean the motor, yet when its condition was casually explained to the proprietor, there seemed to be a difference of opinion on the subject; and since then the commutator shines like gold. This is one of the disadvantages under which the manufacturers of motors labor, and when bye and bye there is a flash and the machinery stops, the illused motor is anathematized and occasionally thrown out for a while to make room for a second hand gas engine! But it goes in again.

Several other elevators were seen operated by five horse power 220 volts Excelsior motors, all of which called forth the highest praise from the users. Most of these are grip hoists carrying from one to one and a half tons, and can be run either by hand or power as circumstances require. In some instances a starting switch is placed on the ground floor and the current only turned on during the time the load is actually being lifted. The car descends by gravity in any case, so that the expense seems to have been reduced to a minimum. At Messrs. Markt & Co., 87 North Moore street, the elevator is run by a ten horse power arc motor suspended from the ceiling in the upper story and belted from a countershaft through a brick wall to the hoist. The motor is only started by the operation of pulling down the elevator cord, which throws a double pole starting switch with carbon contacts placed at the top of the well. When the car reaches the upper floor, the switch is automatically opened, and gravity alone is made use of in the descent.

In the establishment of Wing Bros. & Hart, 81 North Moore street, a ten horse power, ten ampere motor drives a blower and a coffee cleaner. After the roasting is done and the coffee sold, some of it is perhaps bought by the Hotel Vendome where it is ground by two $\frac{1}{8}$ horse power alternating motors in a manner worthy of notice. The



Twin Motors and Coffee Mill.

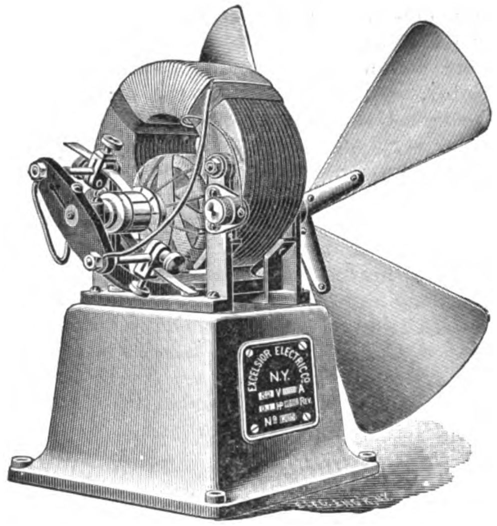
mill at the hotel is fastened upon a heavy deal table and is belted from a twenty inch wheel to a three inch wheel on a countershaft. This countershaft has keyed upon it another twenty inch pulley and this is belted to the Excelsior alternating motors. The latter are operated on the Siamese twin plan. They are bolted on the edge of the table, side by side, and have a common shaft with the pulley midway between them. The current is taken from the nearest chandelier, and the whole arrangement looks more like an ingenious toy than the useful piece of mechanism it is. There can be no question as to the excellent work done by this alternating motor, and one would be glad to see more of them.

The question of ventilation, especially in large and crowded buildings, is one that has burst upon us lately with persistence, refusing to be answered by any but radical measures. Where comfort only was once considered, absolute necessity now demands that the air we breathe shall be comparatively fresh, and even those employers upon whom philanthropic motives have no hold are beginning to understand that the money expended in providing ventilation appliances for their workrooms and factories is more than returned to them by the extra work accomplished in the pure air by their employees. The electric motor has shown itself so eminently adapted to the work of running fans for this purpose that the "fan motor" industry is a business in itself. There are, however, ways and ways of installing ventilating plants, and conditions differ widely according to circumstances. Here again ingenuity has its opportunity.

For instance, the store of Hearn & Co., on West Fourteenth street, is lighted entirely by arc lamps taking current from their own isolated plant in Thirteenth street, directly back of the store. There is no incandescent circuit in the building, and hence none of the various makes of low tension current motors could be used. The Excelsior arc motor, however, rose to the occasion, and through the ingenuity of Mr. Krom, and the careful management of Mr. Ebbert, who has personal supervision of all the electric work on the premises, the system of ventilation is probably unsurpassed by that of any similar building in the city.

The Distributing Ventilator.

The isolated plant occupies the basement of the stable on Thirteenth street. The engine and dynamo room is in the rear, and a narrow passage leads into the boiler and pump room in the front of the basement and extending under the sidewalk. A wide airshaft runs up past the pipes at one side of this room and terminates at a grating on one side of the door of the stable, and about twelve feet from the ground. Behind this grating revolves a 48-inch Blackman exhaust fan, taking the heated air from the boiler-room and keeping up a constantly changing current throughout the whole basement. The fan is driven by a three horse power ten ampere Excelsior arc motor occupying a bracket at the other side of the stable door and belted across the intervening space. The head piece to this article shows the arrangement. On the day when the fan was started for the first time the temperature in the boiler room was 145 degrees. After the motor had run for fifteen minutes the mercury stood at 95 degrees, at which cheerful temperature it remained. The men say that without the fan, they could not possibly have lived in the room during the hot weather of the past summer.


EXCELSIOR ELECTRIC CO. N.Y.

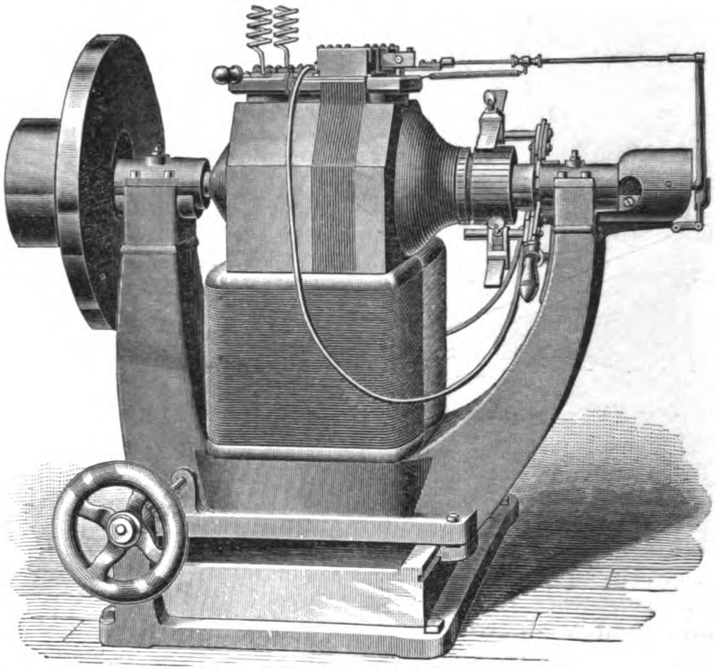
One-Tenth Horse Power Alternating Excelsior Motor.

Across the street in the store, five more Excelsior motors are kept busy bringing air from the roof and distributing it among the counters and aisles where it is most needed. The plan adopted is exceedingly ingenious and merits especial description and illustration.

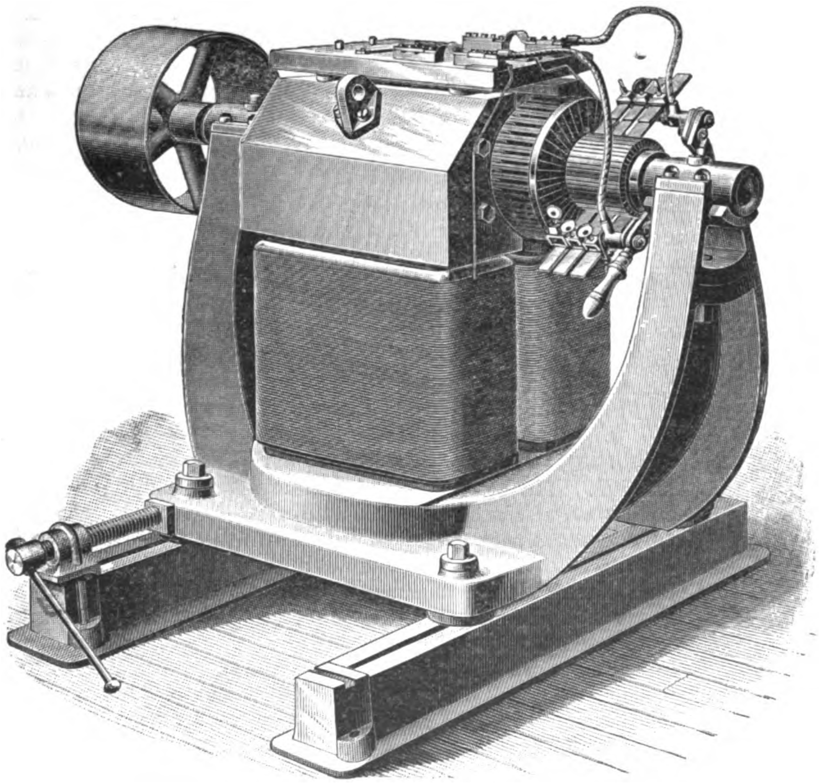
The customary arrangement of shelves and counters in rooms of this character, it will be remembered, is a long row of the former running between two of the latter, the shelves extending some eight or ten feet above the floor. Here, they stop at the height of about six feet and are topped by a long hollow sheet iron flue, or air chamber, having openings at intervals along its sides and a larger one at the end. At the opposite end of the shelf is a little closet with locked glass doors in which runs a motor belted vertically to a fan that forces pure air from the roof into the "distributing box," whence it is furnished to the pleased public and the grateful employees. In other parts of the store where there is no natural ventilation whatever, a horizontal current of air is forced in a solid volume just above the heads of the people, insuring perfect circulation and avoiding direct drafts. There are two motors of three horse power and three of one horse power employed in this work, each running its own fan, and being complete in itself.

On the fourth floor of the building there is plenty of air and no need of artificial breezes, but here again the motor comes to the front, this time as a labor saving device and a patron of the fine arts at one and the same time. Here are rows of girls doing embroidery work in the most intricate patterns, some of which have considerable merit from the designer's point of view. They are sitting at sewing machines, but their feet only move now and then as they start or stop a piece of work, for the machines are all run by electricity, and are geared to a shaft running beneath the floor between them. A friction clutch, operated by the treadle sets them in motion and regulates their speed at will. In this room are fifteen machines in two rows facing each other, and all run by a five horse power Excelsior motor in the corner belted to a countershaft and thence to the line shaft under the machines. A small steam engine formerly attended to this work but was recently invited to send in its resignation.

These are some of the applications of the modern electric motor, as represented by the work of the Excelsior Electric Company in New York City, and they constitute a very good object lesson as to the manner in which the motor can be applied to a variety of work, as a successful Jack-of-all-trades. Here, almost side by side, are three distinct types of motor, made by one company and using three different forms of current, direct high tension, direct low tension and alternating, each doing excellent work and giving the utmost satisfaction in its particular field of usefulness. The Excelsior Company, while they have shown that the use of the arc motor for ordinary business purposes is entirely practicable are untrammeled by exclusive adherence to any one system and can thus range at large through the whole wide field of electric power transmission. It is worthy of mention, too, that these results in New York are duplicated in other cities. I am informed that in Brooklyn, for example, on the circuits of the Municipal and Citizens' Companies, there are no fewer than 50 Excelsior arc motors running very successfully on such work as large wholesale ice cream freezers, saw mills, meat choppers and a toboggan slide. In Chicago a similar experience has been had on an equally large range of work, the motors being placed upon a variety of circuits, and yielding excellent results.



Constant Current Excelsior Motor.



Constant Potential Excelsior Motor.

A POLARIZATION EXPERIMENT.

At a recent meeting of the Physical Society of Berlin, Herr Arons described the following experiment on electrolytic polarization. If we divide an electrolytic vessel with platinum electrodes and acidulated water solution by a partition of some precious metal, such as gold, silver or platinum, a diminution of current is usually observed; and the metallic partition will be hydrogen polarized on one surface and oxygen polarized on the other. Herr Arons experimented with a view to seeing whether he could obtain a thin enough partition for the two polarizations to annul one another. He employed for this purpose an electrolytic vessel 22 cms. long by 5 broad and 8 high, divided in the middle by a sheet of glass pierced by a hole 1.5 cm. in diameter. When the sheet of glass with an unobstructed opening was replaced by one which had the opening covered by a piece of platinum foil 0.1 mm. thick, the deflection of the galvanometer was diminished, and there was a violent ebullition of gas. Gold and silver leaf partitions caused no disturbance. By altering the resistance out of the galvanometer circuit its deflection was in each experiment brought back to its original value. The following figures give the resistance which it was found necessary to take out of circuit in each case: Solid platinum plates, 19 ohms; platinum plate pierced with a hole 3 mm. in diameter, 5 ohms; silver and gold (leaf) 0 ohm; four layers of gold leaf super-posed 0.25 ohm.

APPARENT MAGNETIC RESISTANCE AND CONDUCTIVITY.

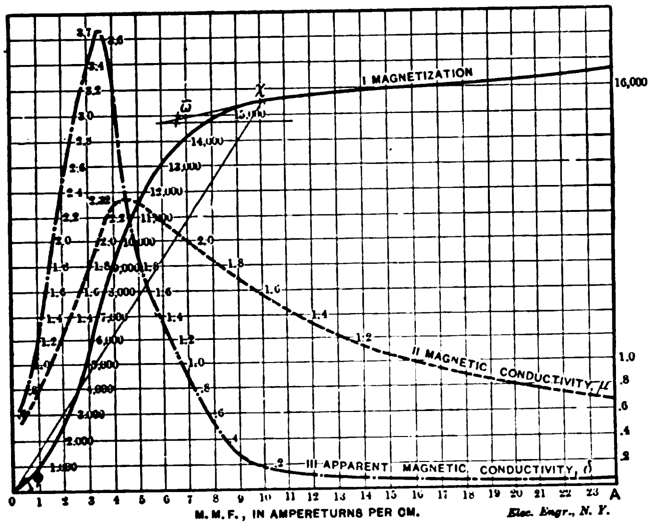
BY

Chas. Steinmetz.

If we subject a magnetic circuit of any kind to a magnetomotive force F, this magnetomotive force F produces a "magnetic current," that is, a certain number of lines of magnetic force M, and as the *magnetic resistance* or *reluctance* of the circuit we define the ratio $P = \frac{F}{M}$; as its magnetic conductivity or permeability, the inverse value, $\mu = \frac{1}{P} = \frac{M}{F}$.

As is well known, in magnetic circuits consisting wholly or partly of iron, etc., the magnetic resistance P and hence the magnetic conductivity μ is a variable quantity and depends largely upon the density of the magnetic current, that is, upon the number of lines of magnetic force passing through the unit of cross-section.

No entirely satisfactory mathematical equation being known for the dependence of the magnetic resistance, and therefore the magnetic current, upon the magnetomotive force, this dependence has for practical use to be plotted in curves; usually in such a way that the abscissæ represent the magnetomotive forces F, preferably in ampere-turns per centimetre or per inch length of the magnetic circuit, while the ordinates represent the magnetic current density in kilolines per square centimetre, or per square inch, as shown in curve I of the accompanying diagram.



Elec. Engr., N. Y.

The magnetic conductivity has a simple geometrical meaning in the characteristic magnetic curve also. Connect any point x of the curve I with the starting point o, then the tangent function of the angle φ between this line x o and axis of abscissæ oA is the magnetic conductivity at the point x:

$$\mu = \frac{M}{F} = \tan \varphi = \tan x \text{ o A}.$$

This allows us to survey the variations of the magnetic conductivity μ by following the radius vector o x, when x travels on the characteristic curve from its starting point to saturation.

We see that the magnetic conductivity is first a minimum, $\mu_0 = \tan \varphi_0 = 500$, and then increases up to a maximum, $\mu^1 = \tan \varphi^1 = 2{,}320$, for the tangent point of the tangent drawn from o upon curve I; and then decreases again, reaching 640 for the magnetomotive force $F = 24$. This value of the tan φ has been plotted in curve II, the susceptibility curve, and shows plainly the rise up to a maximum and then the decrease again.

But we derive still another tangent function from the magnetic characteristic. In drawing at any point x of the curve I a tangent to this curve, this tangent forms an angle ω, with the axis of abscissæ, or with any other horizontal line. The tangent function of this angle ω is what I call the *apparent magnetic conductivity at the point x.* This apparent magnetic conductivity is often of even greater importance than the true magnetic conductivity. It is the magnetic conductivity which a magnetomotive force meets when acting upon a magnetic circuit magnetized already up to the point x by another magnetomotive force.

Let, for instance, a magnetic circuit be magnetized by the magnetomotive force $F = 6$ ampere-turns per centimetre, which produce the magnetism $M = 12.95$ kilolines, per square centimetre. Introducing now in this magnetic circuit a further magnetomotive force of $f = .1$ ampere-turn, this magnetomotive force, superposed upon F, will either increase or decrease, according to its direction, the magnetism M produced by F, to 13.08 or 12.82 kilolines respectively; that is, the magnetomotive force $f = .1$ will produce an additional magnetism, $m = .13$, superposed upon the magnetism $M = 12.95$, caused by $F = 6$, and hence the magnetomotive force f will meet with an apparent magnetic conductivity of $\delta = \frac{m}{f} = 1{,}300$, while the true magnetic conductivity at this point is:

$$\mu = \frac{M}{F} = 2{,}160.$$

This apparent magnetic conductivity will be of importance in all cases where another magnetomotive force is superposed upon a magnetized circuit, as, for instance, in the compound dynamo, in which the magnetomotive force of the series coil is superposed upon the shunt magnetomotive force; or, in the dynamo alternator in which the pulsating armature magnetomotive force is superposed upon the constant field magnetomotive force. This apparent magnetic conductivity is much more variable than the true magnetic conductivity. Twice it has the same value, at the initial point, and at the maximum point of the true magnetic conductivity. Between both points it is larger; beyond the maximum point of true magnetic conductivity it is smaller than the latter, so that it decreases faster than this does.

Following the variations of the tangent of the characteristic curve I we see the apparent magnetic conductivity—plotted in curve III—start at the same point, 500, as curve II, but rise very rapidly up to a maximum value of 3,700, for the magnetization $M = 7.25$ corresponding to a M. M. F., $F = 3.5$, then decrease again just as rapidly, intersect II at 2,320, and rapidly decrease to 100, for $F = 12$, then decreasing very slowly down to 40, for $F = 24$.

It is interesting to note that at about 2.5 ampere-turns the apparent conductivity is more than twice as large as the true conductivity, while at about 14 ampere-turns the apparent conductivity is already less than $\frac{1}{14}$ of the true conductivity.

Of still more importance than for the design of continuous current dynamos is the consideration of the apparent magnetic conductivity in alternating current dynamos. For in the alternator the armature reaction upon the field is well known to be usually much larger than in the continuous current dynamo, because of the very sudden fluctuations of the armature magnetism. At the same time, for the constant potential alternator a small armature reaction is of more importance even than for the continous current dynamo, because the alternator has, besides the drop of potential due to armature resistance and to self-induction, still another cause for a drop of potential with increasing load, which the continuous dynamo current has not.

Now, every time that an armature coil passes in front of a field pole, the current flowing at this moment in the armature coil, throws a magnetomotive force into the magnetic field circuit, which is magnetized by the exciting current. In consequence thereof, the magnetic field circuits are acted upon by two magnetomotive forces, namely, the magnetomotive force of the exciting current, which is supposed to be constant, and the fluctuating magnetomotive force of the armature current. This latter magnetomotive force, if of considerable influence, will not only cause the field magnetism to fluctuate also, and to be a minimum, where it is needed most for inducing electromotive force—thereby changing the shape of the current wave from the true sine shape to a more ragged appearance—but this fluctuation of the field magnetism will induce an alternating electromotive force in the exciting circuit, which, besides causing the exciter dynamo to spark, wastes quite a considerable amount of energy.

From what has been said it is obvious that, to keep the fluctuations of the exciting current of an alternator down as much as possible, the field magnets have to be magnetized up to that point of the magnetic characteristic, at which the apparent magnetic conductivity is very low. For instance, employing iron of the characteristic shown in the diagram, when magnetizing the field with a density of 15,000 lines of magnetic force per sq. cm., in spite of the larger number of exciting turns the fluctuations of the field current will be reduced to about $\frac{1}{12}$ the value they have when the field is magnetized with 8,000 lines per sq. cm. The fluctuation of the field magnetism will even be reduced still more. In practice, indeed, these fluctuations of the exciting current are somewhat decreased in many cases by eddy currents set up in the field iron. But to rely upon eddy currents in the iron is certainly anything but an economical way of dynamo building.

INSULATED ELECTRIC CONDUCTORS.[1]—X.

BY

James Bowstead Williams

Linseed Oil.—This oil is obtained from flax seed either by crushing the seeds and then subjecting them to great pressure, or by dissolving the oil out of the crushed seeds by bisulphide of carbon and then distilling off the solvent for future use. The oil, when pure, is of a clear yellow color; but on account of its high price it is too often adulterated with whale, hemp seed, and other cheaper oils. In fact, there are "linseed oils" in the market which do not contain more than about one-fifth of the genuine oil, the balance being composed of the cheaper oils just mentioned, caustic alkalies dissolved in water, turpentine, etc. The writer has used such oil which had nearly the same specific gravity and color of the pure oil, yet the oil, owing to the alkali present—which virtually caused the oil to become liquid soap—would not only of itself dissolve in cold water but would cause compounds containing the oil, resins, and paraffine to dissolve freely in cold water also. It need hardly be said that such material is worthless for insulation. Moisture is the great foe of insulating material; therefore no material which will combine with, or absorb, moisture should be used for insulation unless such material can be protected from the atmosphere.

Linseed oil is the best oil for use in compounds which are mixed and applied hot, especially those which contain the three hard resins, amber, copal, and shellac, on account of its low freezing point and density. It is also the best oil for paints. When a thin layer of the oil is exposed to the air it gradually changes to an elastic substance resembling rubber, and this in time changes to a brittle resin. This change, or "drying" as it is usually called, takes place much faster in oil which has been boiled, and it is still further hastened by the addition to the oil of "dryers." Dryers are made by boiling with the oil litharge, sulphate of zinc, acetate of lead, etc. Borate of manganese is probably the best dryer now known.

For paints, quickly drying oil is necessary; but for melted compounds, raw oil is preferable as it remains in a liquid state much longer and therefore keeps the compounds flexible for a greater length of time.[2]

Linseed oil dissolves rubber in about five hours at a gentle boiling heat. It also dissolves shellac in about the same time, but it will not dissolve cold copal or amber, even by long-continued boiling. It dissolves the other resins in a few minutes. It does not combine with paraffine wax in all proportions, as the writer has seen published, for, though they mix when heated, most of the wax separates from the oil as soon as the mixture cools. But it will readily unite with suitable compounds formed of the resins and paraffine, in all proportions. In moderate proportions, it combines with rubber compounds containing sulphur if the compounds are subjected to a vulcanizing temperature. If heated with sulphur at 280° F. and upwards it soon changes to a substance resembling rubber. A similar substance can also be obtained by subjecting the oil to the action of chloride of sulphur, and also by mixing the oil with cotton seed oil, coal tar, and sulphur, and then heating the mixture for several hours. But such compounds are not durable if exposed to air and light. If linseed oil, or a mixture of it and other vegetable oils, be distilled with a mixture of nitric and sulphuric acids an artificial rubber is produced which is called elastikon.

Oxidized linseed oil is made by boiling the oil with litharge for several hours and then exposing it, while in thin layers, to the air, or by blowing hot air over thin layers of the oil. It can also be produced by chemicals which are mixed with the oils. These are simply quick processes of changing the oil to the rubber-like substance which all the drying oils undergo, when thin films are exposed. This material is translucent, and has a straw yellow color. It will not stain paper, thus showing that there is no free oil present. It is not a permanent material but is continually changing, by oxidization, to a brittle resin which soon gets full of cracks and admits moisture by capillary attraction. It has been used alone and in combination with resins, etc., but the results were very unsatisfactory. Linseed oil may absorb as much as 50 per cent. of its weight of oxygen.

Cottonseed Oil.—This oil is expressed from the seeds of the cotton plant. It is a drying oil, and can be used to impart flexibility to suitable compounds[3] of the resins, paraffine, etc. It is not as dense as linseed oil, nor has it as low a freezing point; therefore it requires a larger quantity of it in combinations to produce the same results as the linseed. Its specific resistance is about that of linseed but its cost is much less. The effects of chemical agents upon it are practically the same as those on linseed, but linseed is preferable for paints and insulating purposes generally.

Olive Oil.—This oil, when pure, is expressed from the fruit of the olive tree, but, as sold, it is a mixture of clarified cottonseed oil and olive oil, the former often forming as high as three-fourths or more of the whole.[4] This oil is classed among the non-drying oils. Its uses for insulating purposes are very limited, and its place can well be supplied with other and much cheaper oils.

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[2] Whenever the word "paint" is used it means, unless otherwise specified, insulating paints. As will be shown hereafter, the requirements of insulating paints are very different from those of ordinary paints.

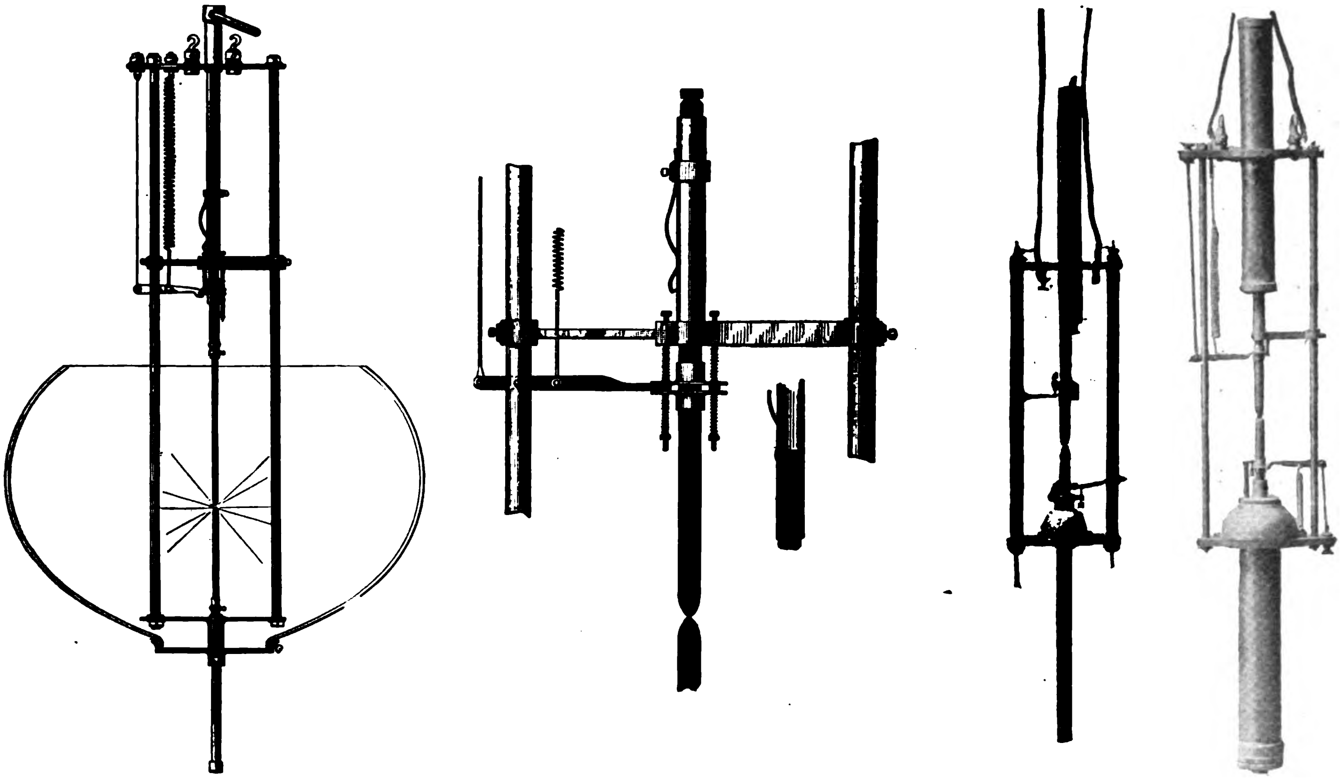
[3] To illustrate what is meant by a "suitable" compound, the following is given as an example: Resin 50, shellac 10, cottonseed oil 30, all by weight. The resins are combined by heat, and the oil then added to the melted resins. Now, if the shellac be 35 parts instead of 10, the combination of resins is not a suitable one, for the shellac will separate when the oil is added.

[4] Probably the only place where the pure oil can be purchased is in Santa Barbara, Cal., from the factory of Mr. Elwood Cooper. But the cost is several dollars per gallon. A written guarantee is given with each purchase of the pure oil.

IRISH'S THERMAL ARC LAMP REGULATOR.

To design an arc lamp equally well adapted to arc, incandescent or alternating circuits, with single, double or magazine carbons, to run singly or in series and to give a light varying from 500 to 3,000 c. p. according to the energy supplied, and to burn from eight up to eighty-four hours or more for each trimming, is a problem which will be admitted to be one of no small magnitude. Yet this has been accomplished in a very simple and ingenious manner by Mr. W. E. Irish, of Cleveland, Ohio.

To obtain this result Mr. Irish has applied a principle employed by him in other inventions of his, among them the thermo-electric telephone, the photo-electrograph, phonautograph, automatic cut-outs, resistance regulators and many other thermo-electric devices, several of which have been described in these columns. In this instance Mr. Irish simply substitutes for the electromagnets usually employed to actuate arc lamps a metallic strip affected to expansion due to the thermal effect of the current passing through it to supply the lamp, of which it forms part. In combination with the thermal expanding strip he employs a lever and counteracting spring.



FIGS. 1, 2, 3 AND 4.—IRISH'S THERMAL ARC LAMP.

The accompanying illustration, Fig. 1, represents a simple form of single carbon lamp to burn from eight to seventeen hours on any circuit; and Fig. 2 is an enlarged view of the mechanism showing the lever, spring, and thermal strip actuating differential clutches which feed the carbon pencil directly without the aid of the usual rod.

The thermal strip, lever, spring and arc form, when the lamp is in circuit, a perfectly automatic balance, operating in the following manner: when the circuit is closed the thermal strip expands by reason of the current, allowing the spring to recoil and raise one end of the lever, which also lifts the upper carbon, thereby establishing the arc; then as the arc varies in length, so in proportion will its resistance vary and so will the length of the thermal strip correspondingly vary. This strip regulates the length of the arc and gradually and imperceptibly feeds the carbon so as to maintain a constant length of arc with an unvarying light.

Lamps may be removed from a circuit of low to a circuit of high tension, or to an alternating circuit and vice versa, and, it is claimed, will work perfectly.

The lamps are easily and quickly adjusted while burning and may be readily regulated to give a maximum length of arc by altering the length of the thermal expansion strip by means of the knurled nut.

On low tension circuits the most satisfactory working limit of arc is reached just before hissing appears, while on high tension circuits the best regulation is effected when the hissing ceases, and on alternating circuits when the lamp burns without noise or with very little noise.

Each lamp is provided with an automatic cut-out as well as a hand switch. The automatic cut-out on a lamp running on an incandescent circuit, as it cuts out the lamp, introduces a resistance equal to that of the lamp when burning. On an arc or alternating circuit the cut-out simply bridges the lamp terminals whenever the lamp circuit opens for any reason. The cut-out will only act when the lamp fails. This arrangement prevents lamps, while burning on a circuit, from being affected by others that may become faulty or have consumed their carbons, and it permits of lamps being trimmed while others on the circuit are in use, although a hand switch is also provided. A shunt of high resistance is employed with the arc lamp.

The engraving, Fig. 3, is made from a photograph of one of the first models of a double-carbon lamp. The upper carbons fall by their own weight and the lower carbon is raised by mercury. This lamp runs about 15 hours without attention. Fig. 4 illustrates a magazine lamp. The carbons in the upper magazine fall in succession, one at a time, with their tapered ends entering a cavity made in the top of the one preceding it. This occurs when the lowermost carbon is about half consumed. As the carbon shortens, the point of junction becomes so heated as to temporarily soften the sealing compound contained in the cavity, and cement the carbons together, so that they feed out as one continuous pencil. The carbons in the lower magazine also dovetail and cement together in succession as they feed up.

The lower magazine contains a quantity of mercury which is employed to force the burning carbon up when the current passing through the lower thermal strip is such as to cause the grip to relax its hold on the carbon.

This lamp will burn twelve hours a day for seven days without attention, or for eighty-six hours. These lamps reach their normal candle power in about thirty seconds and then maintain it.

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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VOL. XIV. NEW YORK, SEPTEMBER 14, 1892. No. 228.

To decry steam and electricity—inventions and products—is to deny the price that civilization has to pay for the use of them.—Frederic Harrison.

NEW YORK IGNORANCE VERSUS AMERICAN APPRECIATION.

VERY much in the same way that a number of able New York politicians went to Chicago to make the Democracy of the country believe that Mr. Cleveland was not the candidate that it wanted or could have, a number of able New York editors have been trying to make the country believe that the trolley system is a bad thing and not what it wants or should put up with. In the one case as in the other, the people appealed to have brushed aside as trivial the objection that anything must be bad because New York thinks it doesn't like it. This is hardly complimentary to New York editorial judgment, and would imply, moreover, that after all what is really required is a little more fact and a little less ignorant argument. If these esteemed colleagues of ours of the daily press cannot travel about a bit, they should at least make an effort to keep their opposition within the bounds of prejudice and let it pass for that. If they travel, they will discover how narrow and unfair has been their view of that which nearly every city in the Union regards as one of the greatest blessings of the age—the "deadly trolley" that has never killed anybody.

It is easy enough to write scare headlines, and to rake up fanciful objections, but it should be not less easy for leaders of public opinion to set forth honestly the points and qualities that tell in favor of a new idea or invention. If they do not take such an attitude of helping toward fuller knowledge, what are they good for? And yet if anybody has been able to find in the New York papers lately anything but abuse, fake "accidents," misrepresentation, prejudice, and the worst kind of medieval conservatism, he must have limited his reading to two journals—the *Sun* and the *Press.* We are glad to be able to mention two that have sensible words, and not a parcel of nonsense, about the trolley; and as other innovations have universally triumphed in the long run of intelligent discussion, we live in hopes of seeing additions to the number of metropolitan papers that can print both sides of the question.

According to the Mohammedan faith, the day of judgment has three periods, each of which is heralded with a blast. The first of the blasts is Consternation, to which succeeds Examination, the final one being that of Resurrection. Our New York papers have fired off their blast of Consternation about the trolley, in magnificent style. The skill shown by some of them in blowing their own trumpet has come in very handily. Just now we are being treated to the blast of Examination, from which good results may be expected, and then later on we shall see a change of heart when our contemporaries will rise on the stepping stones of their old ignorance to higher things, and come to acknowledge in the hour of intellectual Resurrection that the Trolley, equally with the Newspaper, makes for public welfare.

We have referred to the *New York Press.* That journal has not been satisfied with telling how a drunken man sat down on a street railway track on a dark night and naturally got run over by a trolley car, but has started an independent investigation of its own, and has asked the mayors of a large number of towns and cities all over these broad United States what they think of the trolley, from experience of it. That is modern journalism. It is better journalism than giving a good thing a bad name and then repeating it several times like an exorcism. The *Press* printed the replies in its issue of September 4, whether for or against. That, too, is good journalism. News is not partisanship but truth. It happens, however, that there is mighty little evidence sent in against the trolley, and an overwhelming mass of testimony in its favor as safe and popular. Which is just what might have been expected.

This futile struggle against the trolley in New York marks only one stage of advance in electric traction. It is cause for congratulation for every electrical engineer that everywhere outside of New York the trolley has made its fight and won it like a young Corbett. Such victories simply help us to look forward to the time when the public will also have conduit roads, and storage battery cars, too. We are personally as much prejudiced in favor of both these as we are in behalf of the trolley, and we do not let our hopes be dashed by the grim fact that New York's only storage cars were sold as junk last week and that at this very minute the pickaxe is ripping out of Fulton street the last traces of New York's first conduit road. It was our luck to help the first trolley roads go into operation, years ago, when it was predicted that they must fail and that even if they succeeded it would be impossible to run more than two or three cars on any line. Those early systems are superseded and their very methods are forgotten, but the art lives on in higher and higher perfection; and we refuse to believe that either the conduit car or the battery car will not in due time follow in the wake of the trolley car as a living success. Every indication promises their permanence as elements in the domain of electric traction, and unless we mistake the signs, they are coming soon. God speed the day! When they come they will reap some of the richest harvests ever garnered in the boundless fields of electricity. Till they come, the trolley is king, and no amount of abuse or lying will unseat him from the throne. And even when they come, they will but share his kingdom with him. There is room for them all.

GOVERNING DYNAMOS DRIVEN BY WATER WHEELS.

We print in this issue a communication on a subject in which electrical engineers are largely interested, not only on account of the considerable number of dynamo plants now operated by water wheels, but also on account of the many that will be so operated in the future. Where the load on a dynamo is tolerably steady, or its variations are gradual, no difficulty has been experienced in regulating the speed of the turbine within a few per cent. of the normal and for this purpose more than one electrical device has been devised. But when cases arise involving the fluctuation of power such as is experienced in electric railway work, and one of which is cited by our contributor, we believe that experience has shown the inadequacy of the methods now in use for obtaining regulation of speed. Our contributor points out that while a device could be designed to open and close the gates sufficiently quickly to correspond with the change in load, it is doubtful whether it would be feasible considering the shocks which the apparatus would be subjected to in overcoming the accumulated momentum of a large mass of moving water. As a solution of the problem there is suggested a plan which would involve what the writer terms an "automatic load brake," in which dynamos under certain conditions would be employed to act as brakes and by means of which the power given out by the turbine could, if necessary, be constantly maintained at its maximum with the gate full open. As to the efficiency of this method there can be little doubt but that it would be comparatively low, but where the quantity of water available would permit of it that question would hardly enter. It would appear, however, that other methods of an electrical nature are available, and that simple means could be adopted for maintaining constancy of potential at the machine at variable speeds. This could be accomplished in several ways and we leave it to our readers to work out the problem.

THE POPP STORAGE BATTERY DISTRIBUTION SYSTEM.

A storage battery system of distribution, unique in its way, is the Popp system now in operation in Paris, which is described elsewhere in this issue by Mr. Ernst Egger. The plan here put in operation is one which was early proposed and, indeed, put into operation on a small scale in this country some years ago; but we believe that its lack of success, or rather its abandonment, was due to the fact that it was not operated on a sufficiently large scale. The Popp system, as described by Mr. Egger, is evidently one of great simplicity, and so far as its practical operation is concerned has, we believe, met with entire success. It is to be regretted, therefore, that no reliable figures as to the working expenses of the plant are available so that comparison may be drawn between this system and that of direct supply as ordinarily practiced.

ELECTRIC POWER IN THE CITY.

New York City is at present undergoing a silent but none the less remarkable and thorough change in the motive power by which its industries are driven. Right and left, wherever one goes, electric motors are being installed, and the demand for power current is becoming enormous. In this issue, Mr. George B. Muldaur, of the Engineer staff, has an interesting article on a recent tour of observation made by him with the agent of one of the motor companies, who has placed motors on all classes of circuit. That the constant potential motor is a success goes without saying, but it will be a surprise to many people to hear that the arc motors give such satisfactory service. It has been a general opinion that arc motor work was something of a failure, but in this instance the contrary is true. Mr. Muldaur's article touches on various other points of unusual interest.

A STORAGE BATTERY HISTORY.

It has often been remarked that if we could but have access to the records of the trials and failures encountered in men's work it would be of value equal to, if not greater than, that of their successes. Such a record would enable a beginner to avoid many mistakes which consume much time and frequently involve much useless expenditure of money. Probably no more conspicuous example of the value of such a record could be selected than the storage battery. The skeletons that mark the advances of pioneers in this alluring field form a ghastly spectacle, but nevertheless they have their use as finger-posts on the road to success. It is in this light that we begin in this issue the publication of an autobiographical sketch of the storage battery work of Captain A. de Khotinsky. One of the earliest in the field, he has had exceptional opportunities for study as well as for practical experimentation, and the record of his work, we are sure, will prove of benefit to all those who may undertake the building of storage batteries, whether as amateurs or as manufacturers.

THE VIBRATING HELMET IN NERVOUS DISEASES.

We publish on another page a very interesting article on a curious device, known as the vibrating helmet, used effectually as a cure for neurasthenia and complaints in the same category. Dr. William J. Morton, the eminent specialist who recently contributed to our columns an article on the spiral character of electric discharges, has already advanced the theory that in many cases the effect due to the application of the electric current is to put the nerve into mechanical vibration and that the electric action is not the direct salutary agent. Even with this limitation, the electric current seems to be about the only way of reaching the nerve.

TWISTING MAGNETISM.

BY

S. W. Balch

THERE are many traps by which the venturesome inventor is ensnared in Dame Nature's unexplored domain. They are so numerous and crop up in such unexpected places, and they are baited with such inviting prospects that the inventors are indeed few who have not fallen into many of them. Unfortunately, however, they have all been so chargined at their mishaps, and forgetful that similar pitfalls have been the experience of their fellows, that they have rarely made them known to those who follow. Could we but know all the results of past experimental research, and where it has led to failure as well as where it has brought honor to the investigators, we would be appalled at the time that experimenters have wasted in unproductive directions because they have not been warned by those who have pursued the same course before them.

One of the fields which has been especially productive of theories that have not proved true, and experiments that have failed to yield results, is to be found in the investigations that have been conducted with a view to the production of an efficient high voltage dynamo of the so-called unipolar type.

In the unipolar machine the conductor remains constantly in the same magnetic field and the brushes revolve in contact with rings. For these reasons, it affords the two features of a perfectly uniform current in one direction, and there is no point where the circuit is opened and closed as in all other continuous current machines. Part of the electrical circuit has to be through the moving member of the machine, and two commutator brushes or other sliding contacts have to be employed. The main difficulty with this type of machine, however, lies in the fact that the conductor cannot be coiled, and thus repassed through the lines of force so as to multiply the voltage to a useful value.

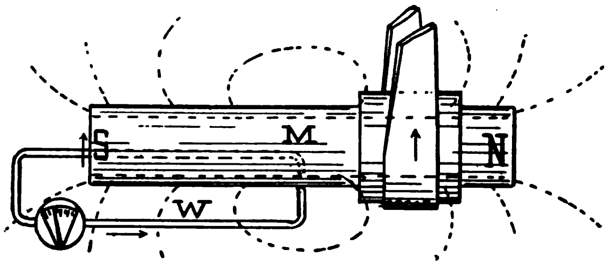


FIG. 1.

Fig. 1 illustrates a simple type of the unipolar machine. A magnet M is mounted in suitable bearings, not shown, and revolved in the direction of the arrow. It is shown as a tubular magnet in order to adapt it to the experiment which will be described later. A stationary loop of wire W has one of its ends in contact with the periphery of the magnet midway between its two poles, and its other end in contact with the interior surface. As the magnet revolves, the lines of force radiating from its poles revolve with it, and these, cutting across the wire loop, according to the accepted explanation, will induce a current through it in the direction indicated. If the experiment is performed with the other end of the magnet the current will be found to be in the opposite direction; but, by reversing the direction in which the magnet is revolved, as in Fig. 2, the current through the conductor will have the same direction as in the former figure. If a soft iron tube is employed, a coil of wire, not shown, will have to be slipped over it to excite the magnetism. It will be immaterial whether the coil of wire revolves with the tube or is stationary while the tube revolves within, as the magnetism resides in the tube and is carried around with it. Thus far theory and experiment are in perfect accord.

The suggestion of revolving the two ends of the magnet in opposite directions at the same time, leads to the joining of the loop shown in Fig. 1 with the loop shown in Fig. 2, and omitting the circuit through the wall of the magnet. Fig. 3 illustrates this experiment. The magnet M is divided at the centre so that there are two independent tubes of iron that can be independently revolved, but, since their unlike poles closely adjoin, they act together as one magnet. The conductor passes through the centre of the two magnets and returns outside, thus completing the circuit without being in contact through the magnet. The conductor may be coiled, if desired, so as to multiply the expected effect. If it will work as the two preceding experiments seems to indicate, then the lines of force radiating from the outer ends as they are revolved, will cut the conductor and generate current. Furthermore, this construction will eliminate all sliding contacts and since the conductor can be coiled, and so repassed indefinitely through the magnetic field, the voltage can be multiplied to a useful figure. Obviously if these advantages were attainable, they would prove a very valuable contribution to dynamo-electric machinery; unfortunately, however, experiment has developed a defect that completely offsets the attainment of these merits on the lines above laid down. Such a machine will not yield even the slightest current.

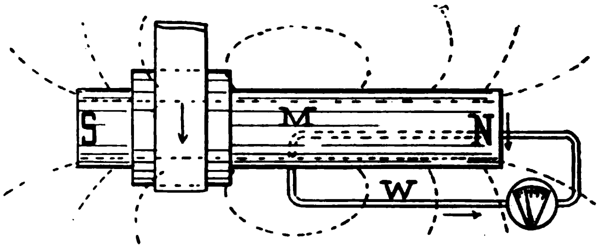


FIG. 2.

Why it should fail to yield a current, it does not seem possible to explain as satisfactorily as might be desired from the electromagnetic laws as they are ordinarily enunciated. The larger part of the magnetic circuit in this experiment is through the air, and an efficient machine would therefore not be expected, but this will not account for an absolutely negative result.

From the fundamental principle of the dynamo, as illustrated in Fig. 4, a similar train of reasoning leads up to a machine for twisting magnetism, as indicated in Fig. 5. In the dynamo, as above shown, the loop of wire wound around the drum twists in the field of the magnet so that a current downward is induced in one side and an upward current is induced in the other side. These currents are in such a direction that they will flow into, and mutually strengthen each other.

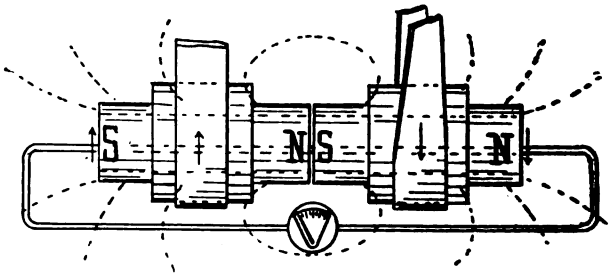
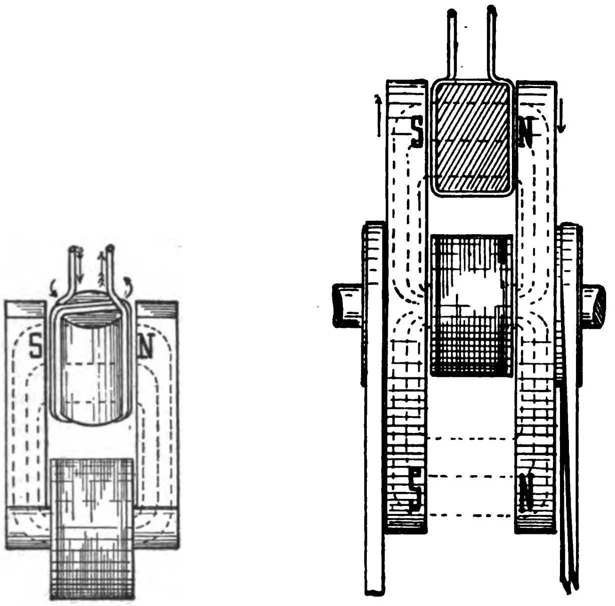


FIG. 3.

In Fig. 5, instead of twisting the loop of wire through the lines of force, an attempt is made to twist these through a stationary loop of wire. The pole-pieces of the field magnets in this experiment are expanded into discs, and these are revolved in contrary direction to that in which the wire was moved in Fig. 4. As the generation of a current in a wire is certainly due to the relative and not to the absolute movement of a conductor with respect to a magnetic field, the conclusion seems irresistible, that if the field is moved with respect to the conductor in the opposite direction to that in which the conductor was moved in Fig. 4, thus producing the same relative movement, then a like current would be generated.

A continuous magnetic circuit, part of which of course is through the air, is a fundamental fact in all dynamo-electric machines. With this circuit, the electrical circuit interlocks, like two links of a chain. In all dynamos the current results from the separation and relinking of these circuits. In the ordinary type of dynamo the electrical circuit is alternately passed in and out of magnetic circuits with opposite directions of polarity. In the unipolar machine, the electrical circuit is continually passing in and out of magnetic circuits with their polarities in the same direction. In the above described experiments, there is introduced as an essential feature of the constructions, the novel idea of continuously twisting the magnetic circuit in one direction, as the candy man does his loop of molasses candy. Although the behavior of copper discs moved in front of the poles of a powerful magnet is suggestive of the presence of a resisting medium similar to molasses, yet when an effort is made to twist the magnetiem in the manner above described the negative results obtained show conclusively that magnetism here ceases to resemble that sticky article.



FIGS. 4 AND 5.

If it should be necessary for the present to explain this anomaly by enunciating a new law that magnetism refuses to twist, it will be well to remember that it is an explanation about on a par with that which contented the ancient philosophers and kept them from discovering the pressure of the atmosphere, when they explained the rise of water to a pump by saying that nature abhors a vacuum.

When the idea of twisting magnetism was advanced by the writer, there was no difficulty in finding electricians who were ready to assert that it would not twist and that it was useless to attempt to fool Nature; but on the other hand, it seems that the idea of exciting the field magnets with the current which they generated—an idea that was likened, before it was tried, to that of a man attempting to lift himself up by his boot-straps—was also an attempt to fool Nature, and one that was so highly successful that it was quite justifiable to attempt to fool her again.

THE ELECTRIC ILLUMINATION OF THE SECTEUR POPP IN PARIS.

BY

Ernst Egger

The employment of storage batteries in central stations is not of long standing, but has, nevertheless, made considerable progress in a short time. In Germany and Austria the following systems have been chiefly carried out:

1. The central station has a small battery for the illumination necessary during daylight.
2. The central station has a large battery for combined operation with the engine plant.
3. Storage batteries are used as compensators in the five-wire system.

Plan No. 1 is probably the oldest and originates from the practice of the smaller plants. There are many plants, in which the consumption of current in the daytime is not more than from 5 to 15 per cent. of the consumption at night. It would not be economical, to run in such cases with the engines; therefore the illumination during the daytime is effected with accumulators. The charging is done during the operation of the machines, which can thus be done at full load. This is an advantage of this method of employing storage batteries. The second plan is different from the first, because for the night lighting; that is, for the heavy consumption of current, the storage batteries are also used. This plan has been carried out in some of the important new large central stations; there the batteries are able to furnish a third of the whole current. The charging is done during the daytime, with steam engines at full load and therefore working economically. This arrangement effects a considerable diminution in the motive power plant of the central station, which is important in stations which are situated in the centre of towns.

The third method is not often used in practice. Storage batteries are coupled on the individual circuits of a five-wire system in parallel with the dynamos, so that they can receive or deliver current, if there are differences of load on the branches.

Besides these cases another sometimes comes into consideration, and that is, to remove the central station out of the territory of consumption, and to place in the latter accumulator substations, which are charged from outside and furnish the desired current. If all these batteries are charged in the daytime, it is possible to save copper and to feed more lamps than the machine plant would otherwise admit of.

The installation of the Secteur Popp in Paris is based on such a plan, but there has been no intention, up to the present, to get a higher discharge current than the charging current; the intention was to overcome the very long distances due to local circumstances. The following will explain this: When the municipality of Paris decided to introduce the electric light, they would not give the concession to one contractor alone, so as to avoid a monopoly. Hence parts of the city, called, "secteurs" were divided among the various contractors. Mr. Popp's secteur is the largest of all, because its centre is near the Bastille and extends on each side to a radius of about 3½ miles. Owing to this great distance a choice of this system of conducting the current was made after the designs of Mr. Solignac. The plan is, to produce in the central station continuous current of high tension, but proportionally small volume.

The charging station is located nearly in the centre of the district, near the Bastille, that is, beyond the city limits, and working with fully-loaded engines, sends out the current to substations, which are proportionally divided in the secteur. These substations consist of storage batteries and the charging current required by them, has the same strength as that delivered by the central station current. They are all connected in series, which makes necessary the high tension employed. The batteries which are to be discharged, are disconnected from the high-tension system, and connected with the secondary illuminating circuits; another set of batteries takes the place of the one discharging, or the latter is merely cut out. By this arrangement the outgoing current is independent of the charging current, and accidents in the central station do not have a sudden influence on the illumination; the security of the operation is therefore increased.

The question is frequently asked as to the economy of this Paris plant. As is well known, we can express the efficiency of a storage battery by the following formula:

$$\eta = \frac{\int c\,\delta\,dt}{\int C\,\Delta\,dt}$$

which represents the quotient of the discharging and charging work. In this equation

c represents the discharging current. ;
C " " charging current;
δ " " discharging potential;
Δ " " charging potential;
t " " time.

This formula applies to any case, no matter how the batteries are connected, whether in series or parallel, and is also applicable in this instance. If

n equal the number of substations;
Δ, the average of the charging tension needed for each substation,
v, the whole drop in the line,

then the central station must produce a tension:

$$V = n\,\Delta + v.$$

Call the intensity of the charging current C, then the work, done by the central station is

$$W = C\,V.$$

Further, if H is the time of operation in hours, then is $\frac{W\,H}{746} = E$, the number of horse power hours, which are delivered into the charging circuit from the central station. With the arbitrary supposition that all the substations will be discharged simultaneously and completely, that is, down to the lowest limit of the drop of potential, we can calculate the work of discharging.

In the Paris plant the maximum volume of the discharging current is the same as that of the charging current; the batteries are so designed, that one could increase the discharging current, but that has not been done up to the present. We therefore want first the value of the discharging potential. All the substations are fitted out with regulating cells, with which the potential can be kept at the same point, designed by δ. Hence the discharging work is:

$$w = n\,\delta\,C.$$

If charging and discharging intensity is the same, then the time in both cases is about the same. The number of horse power hours taken out of the substations is then:

$$e = \frac{w\,H}{746}.$$

We therefore get the economy as follows:

$$\eta = \frac{e}{E} = \frac{w}{W} = \frac{n\,\delta}{V} = \frac{n\,\delta}{n\,\Delta + v}.$$

As the value of $n\,\delta$ is fixed, η, the efficiency is dependent upon V. But Δ again is dependent upon the peculiarities of the accumulators employed; while the drop v is a maximum if all batteries are charged simultaneously, as we assumed by adopting the term n. Both expressions, Δ and v will never exceed the calculable or known maximum measure. We can therefore say, that η will never be subjected to such unfavorable fluctuations, at would bring it beyond the bounds of predetermination. The conjecture made by many that the electric efficiency of the Paris plant, which is not known up to the present, is not very high, is not justified and this the more, as the circumstances which make a proper calculation possible, rarely, if ever, exist.

It is the nature of an electric central station, that the load varies; this is the case here and therefore the assumption is not quite valid, that all batteries will be discharged within H hours and with the intensity C. The discharging current rather will be smaller and therefore the time of discharge longer than H. This includes also temporary changes in the time of charging. All these features cannot be expressed very well in figures, and their influence on the efficiency of the plant cannot be justly estimated. But we can suppose that a very big variation from the theoretical result will not be the consequence. It is wrong and unfair to inquire about the electric efficiency of this plant, and to compare it with other storage battery plants of the usual style; for it is certain that the losses in an ordinary plant with accumulators in parallel, are less, and the efficiency higher. But to get an idea of the efficiency of the Paris Popp plant, it is only right to compare it with other plants, which have to work under similar local circumstances.

I add here some data on the Paris plant.

The central station is located about in the middle of the illuminated district, and is operated by steam. Four upright triple expansion engines of Weiher, Richmond & Co., each of 300 h. p., running at 135 revolutions per minute, are coupled on both sides to dynamos of the Desroziers type, with the well-known disc armature; the connection is effected by means of the Raffard elastic coupling. These dynamos have a capacity of 250 amperes at 400 volts, with the above number of revolutions, and are all connected in series except two of them, which are now serving as a reserve till the circuits are completed. The fields are separately excited by means of eight small Rechniewsky 100-volt dynamos, which are driven by belts from the fly wheels. Each group of machines has its own connecting board, and all the manipulations of connecting and disconnecting can be done there.

The current at present delivered by these machines is 250 amperes at a potential of 2,400 volts, in the charging system (primary network). The latter is laid in underground conduits and consists of a very good insulated cable. To avoid soldering joints the cable is drawn in one continuous length from substation to substation and, besides, is laid double, so that there may be no interruption in case of accident to one of them. The diameter of the conductor is about 0.63 inch. The number of substations is at present 25, but will be increased on 32. They are distributed at proper points in the city—in cellars, stables and similar places—where rent is cheap. From these the secondary conductors are led out which carry the consumption current. They radiate in all directions, are not inter-connected except, of course, at the battery board, and are only 250 metres long (about 800 feet). The diameter of the conductors, like that of the primary cables, is 0.63 inch, and this is a great convenience in laying the circuits. The maximum current passing through this secondary cable is 100 amperes, and the drop at full load 5 volts. Owing to the circumstance that the secondary cables are never longer than 250 metres, the maximum distance between two substations is 500 metres. In most cases, however, they are located much nearer, because the current density per unit section is very great, especially in the interior parts of Paris. The substations are fitted out with two storage batteries at least, each consisting of 53 main cells and three regulating cells, therefore delivering about 105 volts. These batteries are of the Laurent-Cely type and built by the Societé pour le Travail Electrique des Métaux. They have a capacity of 14 watt hours per kilogramme of plate and require a charging current of 0.7 ampere per kilogramme of plate, but can deliver at the rate of 1.5 ampere per kilogramme. This discharge has not yet been called for. There was a possibility of getting along with only one battery in each substation; charged in series it could be discharged parallel with the secondary conductor with 105 volts. But then there would always have been the danger that the high tension could come on the consumption net, and, moreover, the whole independence of the central station would have been lost. This was the reason why two batteries were put in notwithstanding the most careful insulation of the batteries.

To the end that one can connect each battery with the charging or discharging circuit during the operation of the plant there are switchboards in each substation, and with a very practical switch arrangement, including compensating resistances by which every combination can be made easily and without interrupting the current. All the substations are built in the same way and all manipulation is strictly prescribed by the central station; the probability of the assistants in the substations making any mistake is therefore very small.

To indicate how many batteries and during what time they must be charged daily, there are in every substation recording meters, registering the consumption of current, a report of which is sent in the central station every night. From there the superintendent issues orders as to which batteries must be charged the next day, and how long. The man in the substation has no other work but to put the battery from the discharging on to the charging circuit at the prescribed hour, to do the opposite with the second battery, and to interrupt the charging at the time specified. In this way the central station is also prepared for the required power.

As is well known, the E. M. F. must be increased during the charging. The regulating of this is very simple, the central station merely keeping the current of 250 amperes constant, without regard to the voltage.

Finally it must be stated that the whole number of lamps installed now aggregates about 22,000. In this, however, must be included three compressed air substations having a capacity of about 500 h. p., which also furnish current. The entire length of the conductors, working at present, is about 55 miles.

It would be very interesting to know something more definite of the financial aspect of this system, but on this point the writer is unfortunately in the dark.

GOVERNING WATER WHEELS—A SUGGESTION AND AN INQUIRY.

BY A MECHANICAL ENGINEER.

AMONG the problems which have been presented to the mechanical engineer as the result of the rapidly-increasing use of electric transmission, is that of the means of governing water powers so that they shall furnish a constant speed under widely and suddenly varying loads. This question has, until lately, been kept somewhat in the background by a variety of circumstances which, briefly stated, are about as follows: When the mechanical production of electricity first made its appearance among our industries, nearly all the water powers of any consequence in cities or their vicinity were already utilized for manufacturing purposes. As long as only electricity of low tension was used the powers more distant from towns were useless except when, as in the magnificent example at Rochester, N. Y., they were used for arc lighting. In such cases the load, while varying slightly, only did so under the direct control of the engineers, and the changes were gradual and could be cared for. With the arrival of the alternating system of lighting came a wider use of distant powers, but still the load was one varying by slow and small degrees, and the ordinary water-wheel governor could do excellent work.

With the advent of high-tension power distribution, however, and the rapid and enormous increase in its use for railroad work, came a new set of conditions which the old methods failed to meet. When a load varies from maximum to minimum in a few seconds, we have the most severe test to which a governor can be put, and in the use of water for power we have, in addition other factors to increase the difficulty.

On an electric railroad plant the first effect of increased load is naturally to diminish the speed and thus to drop the E. M. F. of the dynamos. The cars all slow down, but the drivers keep the regulating levers where they were, or even throw them further to keep up the speed, giving the water-wheel gates plenty of time to open wide to supply the extra current called for, and then, as the cars rapidly rise in speed, or are thrown off, the generators are relieved of load and the water-wheel speed rises to an extent far beyond what it would, could the E. M. F. have been maintained more nearly constant. So governor after governor is tried and yet none is found satisfactory.

There have been several complaints against the mechanical engineer for not inventing for water wheels a quick-acting governor such as is used on steam engines, but these complaints are founded, I think, upon a misconception of the facts and conditions to be met in the two cases. With steam, we are handling a fluid which has comparatively no weight or viscosity, and which, being under strong compression, will instantly flow wherever it is permitted. We can therefore check and release it as suddenly as we please with no danger, and with the perfect assurance that it will do as we desire. It is by no means easy to make the perfect governor which shall hold a steam engine to absolutely normal speed under wide variations of load, but there are many close approximations and a few well nigh perfect ones.

With water, on the other hand, we are dealing with a fluid which has great weight and viscosity and slight compressibility. Any one who suddenly closes a stop cock in a water pipe while the water is flowing and hears the jar which follows, can easily realize what would be the blow struck if such methods were tried on a pipe six feet in diameter with twenty or thirty feet head. Again, any one who has seen a water pipe burst when under pressure without flow, may have noticed the perceptible check after the first gush until the body of water in the pipe has had time to get into motion. Both these effects can be seen well exhibited in the ordinary hydraulic ram.

To make matters worse and still more widely different, these same properties allow us with steam to get the benefit of placing the governor right at the point where the fluid does its work, while the nearer our governor is to the water wheel, the greater the strain is upon it, owing to the heavier pressure and greater body of water to be handled.

There is no difficulty in making a quick-acting governor which shall shut off the gates as sharply as wanted, and were it feasible to locate these gates at the point where the water enters the flume, we should be so far all right, since the greatest load which could be brought upon them would be only the head necessary to cause the water to flow into the flume, and about fourteen pounds per square inch additional which would be thrown upon them, should we shut the gates so suddenly as absolutely to expose the under side to a vacuum. What kind of commotion would be created in the flume by this I leave my readers to imagine; but besides this, the water already past the gates would still act on the wheel in a very uncertain manner owing to the varying effects of vacuum, momentum and quantity of water.

Is there any other way in which we can solve the problem? Let the electrical engineer decide. So far most of the water powers are ample for the maximum load upon them, and if this load could only be kept constant they would work well. As there is a surplus of water this would practically not cost anything. In one case it is reported that this is done in a minor degree by having a man sit by a brake wheel with his eye on the ammeter, and throw on and off the brake according to the variations of the load, and if this could be done automatically it might pay to do it. Now, many years ago—in 1874, I think—the writer, when studying with Dr. R. M. Ferguson, in Scotland, was familiar with a small dynamo on Ladd's principle, which was used in lectures on electricity. It was a small series-wound machine fitted with a Siemens "H" armature which had two coils at right angles. One coil (the smaller) was used to excite the fields coupled in series with it; the larger to supply the external circuit. When working the machine by hand, it could be driven to a high speed, the total effect of the small armature not being enough to overcome the power. When both coils were put in series, with the fields, however, the machine could only be run slowly, the dynamo "building up" so much under increased speed as simply to hold back against any force which could be applied. It was very curious to start the dynamo from rest and see with what perfect ease it could be run until the critical speed was reached, and how no amount of power could get it above that speed.

This machine and this experiment were exhibited, I believe, before the Royal Scottish Society of Arts, and the writer well remembers Dr. Ferguson, on more than one occasion, calling attention to the fact that it would form a model railroad brake for descending inclines if attached to the axles of the cars, since there was absolutely no danger of "skidding" the wheels, while a certain constant and predetermined speed would be maintained, the only thing to be taken care of being the heat generated. Of course, an additional brake would be required to completely stop trains, since this electrical brake would not possess any power below the speed at which it was meant to begin to act, but this suggestion was made at a time when continuous brakes were very little known and in a country where even to this day the old hand brake is in the large majority.

Now, can we not use a similar device as an automatic load maker? Suppose we take a series-wound dynamo, or a number of them, large enough to absorb the whole power of the water wheels without injury, and belt it to the main shaft. Build this dynamo so that its critical speed shall be reached when the main shaft runs a few turns above normal, and that it shall not begin to build until a few turns below it, using "teaser coils" on the fields if necessary, which teasers can be charged from the main generators or a special machine, if desired. Make the dynamo waterproof and put it in a tank of water, or put it in a tank of insulating oil and keep that cool by water circulation. If this is done, commutators and all can be plunged bodily in.

Now, see what will take place. The moment cars are thrown off, the main shaft, lightened of its load, begins to speed up, and that moment the series dynamo builds up and puts load on until the total equals the former load, and the shaft keeps its speed. Throw load on the generators and the shaft slows a trifle, when the series dynamo dies out and no load is on the shaft but that of the generators. The same amount of electricity is always generated, but the amount from the main generators which passes to line, and the amount from the regulator dynamos used to heat water are constantly varying—that is all. The regular governor will take care of small changes.

Now, let the electrician figure out whether he can build such a dynamo, and if he can, he should have no difficulty in persuading, say, the Neversink Mountain Railroad, at Reading, Pa., to try the device. Of course, I expect to find that the device is patented or has been tried and will not work. If so, I would like to be informed when and where. It would certainly be interesting, as I have never seen or heard of such a device except from Dr. Ferguson in the days which now seem so very long ago—the days when "Gramme's" dynamo was the wonder of the age and the electric light a curiosity to be exhibited in lectures and entertainments.

AURORAL AND EARTH CURRENTS.

BY

THERE can be little doubt, as Mr. D. B. Grandy suggests in the last issue of THE ELECTRICAL ENGINEER, that a comprehensive and systematic course of observation on the part of telegraphers during the periods of auroral disturbances would add much to our knowledge of the nature and cause of earth current phenomena.

The average operator, however, cannot be said to possess the electrical knowledge or the analytical ability necessary for a clear and intelligent appreciation of the circumstances attending these phenomena; and it is extremely doubtful whether it would be found either practicable or profitable to undertake his scientific education on these points, especially in the manner proposed by Mr. Grandy. The operator would be called upon, for instance, to discriminate between the auroral and ordinary signaling current effects; to know exactly the polarity as well as the strength of current actuating his relay; and to understand many other points more or less technical in character, before his judgment could be accepted as having any definite value.

It is highly probable, moreover, that any attempt on a large scale to define the polarity and ascertain even approximately the strength of earth currents by simply noting their effects upon the relay armatures, would tend to develop widely different and anomalous results among the various observers and drive to the very verge of despair the local electrician who might try to restore order out of such chaos.

There is, fortunately, a simpler way in which the ordinary operator can aid the cause of science during these disturbance periods, and that is, by carefully noting the circuits that are *absolutely unaffected* by the passing storms. The direction of such circuits will show the equipotential planes, which are known to be at right angles to the direction taken by the disturbing forces, which are believed to have their origin in sun spots. It is beyond question that the effects noted at such times are *not* the result of local causes, for it invariably happens that telegraph wires in every section of the globe are affected simultaneously with the appearance of unusual solar activity.

The principal points to be observed in case of further disturbances of this nature are as follows:

(1.) Note the times of appearance and disappearance of the phenomena, as well as the periods of maximum intensity.

(2.) Make a record of the differences of potential shown between the terminal grounds of the circuits affected, and,

(3.) Ascertain the geographical direction of the wires most affected as well as of those least affected by the earth currents.

The ordinary operator can be of considerable assistance in determining (1) and (3), but the measurements and calculations involved in (2) can only be accurately made by those having some technical knowledge and skill, and equipped with the necessary apparatus for making such tests.

THE MANUFACTURE OF HIGH VOLTAGE INCANDESCENT LAMPS.

BY

Henry E. Viening

I HAVE noticed from articles that have recently made their appearance in THE ELECTRICAL ENGINEER, that the attention of lamp makers is now being concentrated on the manufacture of high voltage lamps, by which I mean lamps of 150 to 300 volts, and a short consideration of the subject will be found profitable to companies and other individuals to whom economy is of importance in the use of the electric current for purposes of lighting.

The benefit to be derived from a high voltage lamp is at the present moment almost incalculable, and the field for such enormous, for by its application to existing central stations, the capacity of their mains would be doubled, and in many cases trebled ; and it would also enable those who generate continuous currents to extend satisfactorily, and with increased profit, their present limit of service from 40 to 70 per cent. at an enormously reduced first cost for copper.

The recent article of Capt. A. de Khotinsky, wherein he deals with the difficulties of manufacture, and the increased cost of the lamps, and also suggests the feasibility of doubling the length of a 10 c. p. 100-volt filament in order to produce a 200-volt lamp, shows me that he has studied the subject closely, and understands the details of manufacture well, and the experience which I have gained from close experiment in the same line some few years ago, leads me to agree with him, in his statement that the brush effect developed on the pumps in high voltage lamps is due entirely to the resistance of the joints and the vacuum.

Furthermore, the quality of the glass is an all-important point in the manufacture of incandescent lamps, and fully 90 per cent. of the troubles of a lamp maker's life are due to inferior glass; and the quality of the finished product depends upon the quality of material used in this respect, whether 50, 100, 200 or 300 volt lamps.

There is no doubt that it is possible to make lamps of a high voltage by the apparently simple process of lengthening the filament, but as to whether they can be successfully produced by this method so as to sell at a reasonable price is open, in my mind, to grave doubt on account of the enormous loss in carbonizing and the treatment the filaments have to undergo previous to insertion in the lamp bulb. The only fibrous material of which a filament can be made successfully for a high voltage lamp is bamboo. Now the length of clear fibre, that is, one without knots, to be available for a filament, is limited to about seven inches, for if this length is exceeded the product becomes very doubtful. Again, if the filament is lengthened, it becomes necessary to use a third support to prevent vibration, which must of necessity increase the cost of production, and nearly, if not quite, counterbalance the money saved in copper.

Lately I have succeeded in making a number of lamps of a voltage ranging from 200 to 280, with a life of over 500 hours, at 3.6 watts per candle power, without having to lengthen the filament or to resort to any device other than the ordinary process now in use for 100-volt lamps, with the exception of the chemical treatment of the fibre previous to carbonization, which treatment of itself is inexpensive, an outlay of $1 being sufficient to treat 1,000 fibres.

The features of a high voltage lamp thus made are many, and a brief enumeration of them may not be out of place here, in order to impress on the minds of those who are now ignorant of the value of the lamps, points that they will easily recognize when they refer to the lamps now in general use.

Blackening.—The blackening common to ordinary lamps is almost done away with in lamps of 150 to 200 volts, 16 c. p., after 500 hours at 3.6 watts per candle.

Uniformity.—The higher the voltage the greater the margin of resistance within which the lamps are practically the same candle power, rendering, therefore, a greater percentage of the make of uniform candle power.

Fall of Resistance.—During exhaustion, the fall of resistance of the filament is 50 per cent. less in proportion to lamps of lower voltage.

Regarding the brush discharge mentioned above, I have found that this can be done away with by nickel-plating or carbon-plating the joint as in the majority of modern lamps, instead of using cement.

The conclusions which I would draw from the above are that lamp makers who are now grappling with the subject of high voltage lamps will find the solution of the problem in the chemical treatment of the fibre, rather than in the use of mechanical devices.

THE VIBRATING ELECTRIC HELMET FOR NERVOUS DISEASES.

AMONG all the methods, more or less curious, applied to the treatment of nervous diseases there is certainly none which is more original than that which has been applied for some time at the Salpetrière Hospital, in Paris, by Prof. Charcot. It is a treatment by means of mechanical vibrations, which have been shown to have a marked effect in soothing the nerves. This vibration cure has for some time been specially studied by a pupil of Prof. Charcot, Dr. Gilles de la Tourette. With the assistance of two colleagues, well versed in electro-therapeutics, MM. Gautier and Larat, he has constructed an apparatus for the treatment of headaches and similar nervous affections of the brain. It is termed the vibrating helmet. It resembles an ancient helmet and is, in fact, constructed of sheets of steel which permit the top of the head to be thoroughly encased, as shown in Fig. 1. The interior construction will be readily understood by referring to Fig. 2. Mounted upon this helmet is a small alternating current motor making about

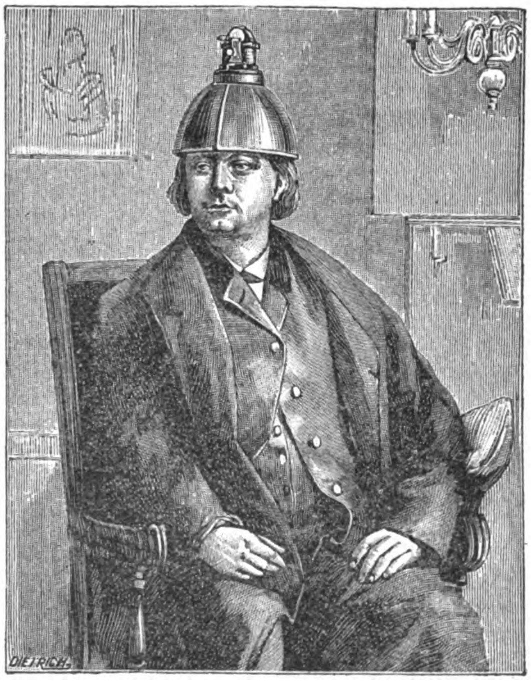
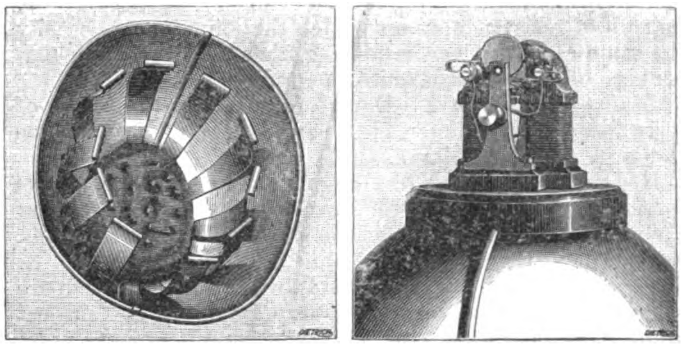


FIG. 1.—THE VIBRATING ELECTRIC HELMET.

six hundred revolutions per minute. At each revolution a uniform vibration is transmitted to the metallic springs and is communicated to the skull against which they are pressed. The walls of the skull are thus vibrated in their entirety, and these vibrations naturally are transmitted to the cerebral structure. The sensation is not disagreeable and the number and intensity of the vibrations can be varied according to the patient treated. The machine produces a rumbling sound which contributes to benumb the faculties. At the end of some minutes the patient experiences a general lassitude and a tendency to sleep, putting nervous people and those afflicted with insomnia into a salutary repose. The vibrating helmet has already been applied in a large number of cases of neurasthenia and similar diseases, and in the majority of cases with good results. The process is also successful in the case of headache, and as this is a widespread complaint, against which there is no sure remedy, it is possible that the vibrating helmets will become quite the fashion; something that no home or family can dispense with.



FIGS. 2 AND 3.—THE VIBRATING ELECTRIC HELMET.

THE NEW YORK STATE BUILDING AT THE WORLD'S FAIR.

A STRIKING feature of the building will be its exterior illumination by electricity. The belt course marking the second story will be strung around three sides with incandescent lights of different colors, and about the entrance, above which the seal of the State of New York is set, a myriad of fiery diamond jewels. A second line of these lights will deck the entablature of the main building, while a third and fourth line will set off the cornice of the upper deck, and define and outline the arches, angles and cornices of the two belvederes. Finally a cluster of lamps will illuminate the base of the flagstaffs, surmounting the belvederes.

A NEW PROPERTY.

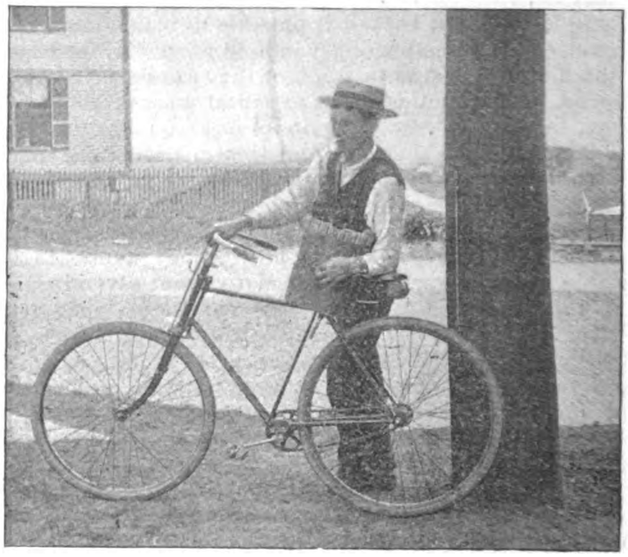
IN an investigation on the properties of lamellar bimetallic conductors under the influence of electromagnetic induction, says the London *Electrical Review*, MM. Ch. Regnier and Gabriel Parrot have reported to the Paris Academy of Science that they have obtained an arrangement recalling the well-known "Faraday's disc," by substituting for the usual copper conductors thin plates of a certain constitution. These plates are composed in the direction of their thickness, of a very magnetic and highly conducting metal, and so placed that the lines of force of the electromagnetic field are perpendicular to this direction of thickness. The flow of induction which proceeds from the north pole is divided into several sheets of parallel lines, which are very close together, and which only traverse the metallic portions of the bimetallic conductors, the tubes of force becoming cylindrical. In this arrangement of conductors MM. Regnier and Parrot found that the available energy increases at a rate which is practically proportional to the height of the conductors. They constructed a small machine on this principle, and obtained with a load of 750 kilogrammes and a velocity of 500 revolutions, 32,000 watts; and this they found worked out to an output of 42 watts per kilogramme of the machine. Further details of this newly discovered property of lamellar bimetallic conductors may may be found in a paper in the *Comptes Rendus*, August 8th.

ANTIMONY IN ELECTROLYTIC COPPER.

HERR W. HAMPE states in the *Chemiker Zeitung* that all the specimens of electrolytic copper which he has examined contained a small proportion of antimony ranging from 0.007 to 0.02 per cent. The precipitation of antimony from the copper ore might be checked if the sulphuric acid were not used for so long a time, and thus did not become so highly charged with impurities, but except for laboratory purposes the extra expense involved in the increased consumption of acid would not be proportionate to the advantages gained by the elimination of the antimony.

A BICYCLIST LAMP TRIMMER.

IN our issue of August 24, we illustrated the central station of the Concord Gaslight Company, at Concord, N. H., and in the article, mention was made of the fact that the lamp trimmer used a bicycle in the pursuance of his daily occupation. We are now enabled to present to our readers an engraving showing the trimmer, Mr. James Urquhart, standing beside his bicycle all ready to begin work. The bicycle is a Grendon safety, manufactured by the Grendon Iron Wheel Company, of Toledo, O., weighs 47 pounds, and is geared to 58 inches. In all there are about 65 lamps to be trimmed on two circuits measuring together about 16 miles, the two lamps furthest from each other being about 2¼ miles apart. On a pleasant day it takes about eight hours to trim the lamps, and after the lamps are started, Mr. Urquhart goes over the circuits once more to make sure that all the lamps are burning properly, occupying about 1½ hours in the operation. The bicyle has proved quite a success in Concord, and saves a large amount of time and labor, and could well be applied to other cities.



A BICYCLIST LAMP TRIMMER.

Letters to the Editor.

ON THE PROSPECT OF STORAGE BATTERIES FOR ELECTRIC TRACTION.

One of the great questions of the present day to which almost every citizen is giving particular attention, is that of solving the rapid transit problem in such a manner as will best meet the interests of the public generally. Of course every one looks (and justly) to electricity as the power by which the problem is to be solved. To a considerable extent it has done so already in shape of the much discussed and freely abused trolley system. It is a well-known fact that up to the present time, as viewed from a commercial standpoint, the trolley system is the cheapest and best. From the standpoint however of public favor, it is very far from the ideal we look for and expect. It is needless to reiterate the main reasons for the public disfavor of the trolley system beyond the statements that as regards appearance, comfort and safety, it is not now, and is never likely to be the system which the public requires and is looking for. If there were no prospects whatever of anything better, there might be some excuse for those who recommend householders to suffer the disfigurement of their streets, the extra noise of the trolley cars, and the risk of their lives. But now comes the question, Is there no prospect of anything better? Those financially interested in overhead railroad systems will either answer: "No, no prospect whatever," or keep discreetly silent. But the answer of the unbiased and unprejudiced naturally is—"Yes there are prospects of better systems." Confining oneself to the electrical field there is the underground traction system, and last but not least the storage battery system. Of the two prospective systems the public look with the greatest favor and hope toward the latter. A successful underground system is decidedly better than the overhead; but a successful storage battery system would undobtedly be the best of all. Advocates of both the overhead and underground systems are in the habit of stating that there is no prospect whatever of a successful storage battery system or, at least, so remote is the prospect that it is unworthy of present attention. The statement is very freely made that every attempt so far has proved an unmitigated failure. There is undoubtedly a great deal of truth in this statement; but not so in the statement of there being little or no prospect of future success. Those who have given special study to this industry and have a practical experience in the actual working, together with a thorough technical knowledge of the requirements and capabilities of storage batteries of various types, do not agree with the pessimists of the electric storage systems as applied to street cars. There are moreover at the present time some very mistaken ideas amongst the public in general as regards the true state of the art, and also as regards the direction from which ultimate success may be first expected. One is accustomed every now and then to see a long and elaborate description of some *new system* (so called) under some such head as "The Problem Solved," "A Successful Electric Storage System for Cars," "The New Battery for Storage Cars," "Most Successful Experiments," "The System to be Universally Adopted by the —— R. R. Company," etc., etc. Under some such heading one finds a long description of a beautifully painted, decorated and electrically equipped car, possessing a number of novel features. We are informed how some dozen or so railroad men and experts, etc., mounted the said car, and under the guidance of a driver of no electrical knowledge (as no such knowledge is required, everything being so simple and under perfect control), they were piloted over a road of some four or five miles. We are told how they mounted several grades on which they stopped and started with perfect ease; how they were propelled at the rate of 12 to 15 miles an hour without any apparent injury to the battery. Upon their safe return these experts are stated to have commented most favorably upon the excellent mechanism, the enormous power stored, the smoothness of the motion; and finally gave it as their unanimous verdict that the experiment was a most pronounced success, and to the best of their belief the first and only success in this line. In many cases beyond the fact of offering stock for sale, etc., one hears no more of this particular and successful new system These demonstrations may be all very well in their way as far as maintaining the public interest in the matter is concerned; but they have the unfortunate tendency to spread the opinion (especially amongst purchasers of stock) that another failure has been added to the list. Now the public should be apprised of the fact that there is no question whatever at the present time, and has been no question whatever for years but what storage battery cars can run as smoothly; be as easily handled; attain the same speed; mount equal grades; stop, reverse, and in fact do all and everything equally well, and sometimes better than any other electrical system either overhead or underground. A great deal is made out of the fact of the great extra weight. It is upon the strength of an enormous reduction of this said weight, that inventors and advocates of the numerous so-called "entirely new and improved storage systems" attract their patrons. In some cases a certain reduction of weight may be made, but it is usually at the sacrifice of stability and strength. As a matter of fact this subject of reduction of weight is not nearly so important as the public are led to suppose. A reduction of 50 per cent. of battery weight would on an average mean a saving of 10 per cent. of total weight upon a car capable of seating from 30 to 40 passengers.

Now those who have practical and technical experience in this business know that the extra cost of operating, consequent upon the additional ten per cent. of weight, is very far from a serious item, but an item, in fact, which can be very easily exceeded by extra cost of depreciation consequent upon reduction of strength and stability in attaining the 10 per cent. reduction of weight. It is true a firm roadbed as well as good rails should be used when extra heavy cars are run; but neither the roadbed nor the rails have to be of superior construction or more expensive nature than should be the case with every well-built street car line. A great deal is made of the total extra weight to be carried on a car which, without said battery and with forty passengers, would weigh, say, 20 per cent. less. What car line is not in the habit of allowing an excess of 20 per cent. of weight of passengers over its seating capacity. As they represent five cents apiece nothing is said about the extra weight. Even 20 per cent. extra weight does not so seriously effect the extra cost of operating expenses as some would like the public to suppose. Thus with the facts before us that a storage battery car can do all and everything as well and perhaps better than any other electric car, that the weight is an overrated objection, it may be justly asked, Why have they not been successful? The answer to this is very simple. Because hitherto the cost of operating—in consequence of the depreciation of the batteries themselves—has been too high. The cost of prime motive power is less with storage batteries than without. Now, the only way of proving the success of any storage car system is in the first place for the owners to make a contract with some good representative street car company, by which said owners undertake to operate and maintain their batteries in proper working order upon a fair number of cars at a fixed price per car mile.

If such a contract is taken at a price satisfactory to the car company, this is the first step towards the required proof. If at the end of the first term the contractors are prepared to renew said contract on same or equally satisfactory terms, having by their previous operation given sufficient satisfaction to the car company to warrant such renewal, then we come to the second and very important step towards the final proof. The last and most important step is for the contractors to prove that they are operating on a profitable basis. This can be shown by their books or by their willingness to take further contracts upon the same terms. Numerous contracts of the above nature have been made and started upon. Some have resulted, so far as they went, in the satisfaction of only one party to the contract; usually the car company. In others, again, there has been general dissatisfaction all round. In all cases, however, difficulties and disagreements have arisen at the second or third stage of the drama, namely, the renewal and extensions of the contracts. Numerous excuses have been made, the principal of which is lack of funds. For ample funds there must be ample faith. It is the lack of faith that has produced the lack of funds. All these contracts, however, no matter how short a time they may have lasted, have resulted in some good, namely the acquiring of practical experience as to requirements in actual working. Each so-called experiment has been one step ahead. It is from those who have been thus steadily working ahead in this field that the long-wished-for result must be looked for. Those who have devoted many years of study and close attention to this special subject as a rule do not expect to see the sudden solution of the problem arise from some great and unexpected discovery. Of course it must not be denied there is a possibility of something new and unexpected suddenly coming to the front; but the possibilities of such appear greatest to those who have the least knowledge and experience in this branch of science. Most scientists will probably agree that it is to the developments and improvements which have resulted from continued study and experience of present systems that we must look for the solution of the problem. Storage batteries as applied to electric lighting began to come forcibly before the public some ten years ago. For many years they met with little or no financial success. The subject was carefully studied and the business practically developed until at the present time (in Europe especially) the electric accumulator as applied to electric lighting is a financial success. It was not, however, until substantial guarantees were given and carried out by the manufacturers for operating and maintaining storage batteries at a fixed price (as is now being done in many instances in Europe) that their success was assured beyond question. Electric storage batteries as applied to traction purposes are going through the same course of development, and it is from those who have been continually working in this field and who have achieved the practical results so far attained, and by whom the experience has been gained for making the nececessary improvements, that we must look for the success which is to be. The probabilities are greatly against the solution of the problem from the sudden inspiration of one who has but quite recently given attention to the subject; one who has probably forsaken his calling and business to become a full fledged inventor and electrician and make a great discovery. Such discovery usually upon inspection is found to be only a case of history repeating itself; a device in fact which was originally discovered many years ago, and has been steadily and unfailingly rediscovered many times every year since It is not from such as these, of which the number is legion and still increasing that the public will in all probability see the hoped-for result.

If such a discovery should be made at all it is much more likely to come from one of those who has given continuous and close study to the subject. These are the very ones, however, who agree in thinking the problem is much more likely to be solved by some of those now engaged in the practical development of systems in which already the principal obstacles have been overcome, and in which it is merely a matter of time when the final goal will be reached. As a last question which the patient public may justly ask: How soon may this long-looked-for and long-wished-for result be expected? It may be stated in reply that in all probability even the next few months may show some decidedly encouraging advances. There are at present in different quarters of the globe some of the most practical undertakings in this line being developed. Contracts such as described above have been entered into by experienced and substantial firms. The contracts are now entering upon the second stage—namely, that of renewal and extensions. These are being watched with the utmost interest as apparently at no previous occcasion have the contractors been in a more substantial position and with a better knowledge of their subject than at the present time. Results so far give every promise in the very near future of a practical proof beyond all question that the storage system is bound to be *the* system by which the problem of rapid transit will be solved.

GAUTHEROT.

NEW YORK, Sept. 7, 1892.

THE HAMMER EFFECT OF LOCOMOTIVE DRIVING RODS.

IN Mr. Sprague's admirable inaugural address before the American Institute of Electrical Engineers, he thinks "it fair to say that the so-called hammering effect on the rails said to take place in the ordinary locomotive driver where the weights are counterbalanced, exists more in imagination than in fact."

Mr. Sprague does not seem to understand that the unbalanced feature of the locomotive of which a great deal has been said is not so much in the driving wheels or connecting rods as it is in the driving rods. In the absence of any practicable plan, locomotive builders do not pretend to put them in running balance; the result is, the machine rocks and noses around, and delivers trip-hammer blows to the rails at each revolution of the drivers. In electric locomotives, Mr. Stephen D. Field and the writer have independently demonstrated certain advantages, and the practicability of driving connecting rods from their centres without intervening driving rods; we have all of the advantages of the connecting rod, (some of which are important ones) and at the same time avoid the destructive effects referred to which have haunted locomotive builders for the past seventy years.

JOHN C. HENRY.

NEW YORK, Sept. 3, 1892.

A CANADIAN POWER TRANSMISSION PROJECT.

WHAT will probably be the first attempt to use power from Niagara on a large scale and at long distances is likely to materialize here very shortly.

A company has been formed with a capital of $3,000,000 to construct some 200 miles of electric railway in distances of 25 to 60 miles, and to supply light, heat and power to the towns and cities along each line. It is intended to make Hamilton the centre of the system and bring the power here at a very high voltage, possibly 25,000, which is recommended by Messrs. Brown, Boveri & Co. after their experience at Lauffen Falls.

The company will, as far as possible, use existing roads, fencing off what is required for single tracks and using large trolley cars and trailers. The lines have been partly surveyed and it is expected that the whole system can be completed early next summer. Considerable attention will be devoted to the supply of power for manufacturing, and they will also endeavor to introduce it largely for cooking and heating.

JOHN PATTERSON.

HAMILTON, ONTARIO, Aug. 30, 1892.

HOW TROLLEY ACCIDENTS HAPPEN.

IT was on a Back Bay car. At —— street she stopped the car, and, upon reaching the crowded platform, attempted to get off on the wrong side. "The other side, madam," said the conductor. "I want to get off on this side," she insisted. "You can't do it, madam," was the reply. "Conductor!" she exclaimed indignantly, "I want to get off on this side of the car." Whereupon the polite official of the West End, in a loud voice, remarked, "Gentlemen, please stand aside and let the lady climb the gate." —*Boston Transcript.*

Literature.

Street Railways; their Construction, Operation and Maintenance. A Practical Handbook for Street Railway Men. By C. D. Fairchild. 426 pp. 9 x 11½ inches. Price, $4. Illus. New York: 1892. *The Railway Publishing Co.*

THE transportation of passengers from point to point within the limits of a city in a convenient manner and at a cost which will enable all to avail themselves of the facilities offered is by no means a problem easy of solution. The fundamental principles, indeed, are simple enough, but the comparatively recent adoption of street railways shows that it required considerable hardihood on the part of their promoters to convince the public, and especially the investing public, of their financial feasibility. It is scarcely thirty years ago that the first street railway or tramway, in the true sense of the word, was put in operation, yet we need only point to the record of work in this country alone to illustrate the favor with which street railways are looked upon by the public at large. But thirty years have also brought about a remarkable change in the engineering character of street railways. The horse road, which for over twenty years practically had no competitor, is gradually being supplanted by other systems, and a record of the conditions of the art as it exists to-day presents a most varied and interesting picture. In the work before us the author has treated the subject in the broadest sense, giving first a very comprehensive view of the actual methods employed, and then entering into many details of the construction and the management of roads, which are here probably brought together for the first time.

The importance which the electric system of street car propulsion has now attained probably justly entitles it to first consideration, and hence we find the author introducing his work directly with a description of this system in a very brief but clear outline of the principles underlying the generation of the electric current in the dynamo. This is followed by a description of the machines most generally employed for that purpose at present, and he then takes up the method of conducting the current from the power house to the car. There is also introduced a description of the various types of poles and overhead construction. The return circuit also receives very thorough treatment, the author describing the various methods of bonding with the different types of rail employed. That most important detail, the overhead line, is next taken up in order and the various types of insulators and brackets for the suspension of the overhead system are very fully described, together with the method of their erection.

The author then turns his attention to the various types of motors in general use and their method of mounting on the truck, with the electrical connection generally employed. At this point, also, is introduced the subject of storage battery traction, the main features of which are described. The author then passes to the power house, giving a full description of the methods of construction adopted in some of the best stations in the country, including both the motive power and the switchboard arrangement. This chapter is very appropriately brought to a close by an excellent résumé of the proper methods to be adopted for maintaining an electric railway in good condition, a subject which ought to be thoroughly impressed upon all electric street railway managers. In this section on electric traction the author is naturally limited by space to the enumeration of the most essential details. but it would seem that a mention, however brief, of the work accomplished in conduit railways, such as that now in operation at Budapest would have added to the completeness of this chapter. But the author had to "shut down" on new copy at some point or other.

In the chapter on cable traction which follows we find a very thorough discussion of the methods of street railway construction which have proved most successful; and which is followed by that important detail, the grip. The cable itself is next taken up and the various methods of splicing are described. The driving machinery is very thoroughly treated, and some of the arrangements adopted in the largest cable installations are described. The other details which go to make up successful cable traction, such as the type of rope, etc., are given, and the chapter closes with a brief review of the cost of cable road construction and operating expenses, which affords a basis for interesting comparison with similar data in electric railway work.

But while electric and cable traction are rapidly supplanting all other methods the author has not lost sight of the fact that there are still a large number of horse roads in operation, and hence their consideration in this work is eminently proper. Special stress is laid upon the proper selection of animals, and the results of long experience in this particular field are given by the author. He then passes on to the best method of feeding, stabling and general care of the animals, and the proper design of car houses and stables. Steam, air and gas motors are next taken up and described in a short chapter, in which we find the most important of these types of locomotives described. Following this are chapters on inclined planes, rack rail inclines and elevated roads, in which various details of construction of these types are very fully dealt with. The author next devotes considerable space to the subject of car building, a most interesting chapter, and one which is full of practical hints and suggestions. The roadbed or track construction, upon which the success of every type of road must depend, has justly been accorded a chapter by itself, in which we find descriptions of the principal types of rails employed and the method of their laying on roads of different types. The subject of curve construction and crossing is also gone into with considerable fullness. Discipline and rules and the book-keeping and classification of railway accounts form the subject-matter of the next two chapters, and, if thoroughly carried out, will benefit both the stockholders of the railway as well as the traveling public. For those intending to enter into the field of street railways, the chapter on charter, franchise, stocks and bonds will prove exceedingly valuable. The work is brought to a close with a large number of illustrations of the leading types of cars now in general use, and with a description of the thousand and one auxiliary appliances required in the equipment of street railways, such as track tools, fare registers, car heaters, lamps, brakes, etc.

It has evidently been Mr. Fairchild's aim throughout to place the subject-matter before the reader in such a manner that even those little versed in technical matters will be able to gather a correct understanding of the various systems, and to form an opinion of their relative merits viewed from both a mechanical and a commercial standpoint. The illustrations throughout are admirable, and, together with the lucid text, make this the best compendium on the subject extant. Mr. Fairchild and his publishers are to be congratulated.

Fourth Annual Report of the Department of Public Safety, City of Pittsburgh. Year ending Jan. 31, 1892.

A most interesting volume, full of valuable statistics and data as to city work.

Inventors' Record.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED AUG. 30, 1892.

Accumulators:—

Secondary Battery, W. W. Griscom. Haverford College, 481,560. Filed Nov. 16, 1891.

Employs plates having perforations extending therethrough, and having two opposite concave walls.

Alarms and Signals:—

Auxiliary Fire Alarm System, J. Sachs, New York, 481,590. Filed Mar. 29, 1892.

A system by means of which an alarm can be sent from an auxiliary box at any distance from the street fire alarm mechanism.

Signal Timing Apparatus, H. A. Chase, Boston, Mass., 481,618. Filed May 11, 1892.

Employs a recording apparatus situated in a local circuit controlled by a relay included in the main line circuit.

Electric Door Alarm, M. W. Bessey, Waterville, Me., 481,711. Filed Nov. 14, 1891.

Fire Alarm Telegraph, A. J. Coffee, Portland, Ore., 481,847. Filed May 12, 1892.

Employs an automatic and permanent lock for the auxiliary box mechanism of a fire alarm system.

Electric Guest Call, F. Benner, Minneapolis, Minn., 481,919. Filed Oct. 26, 1891.

Conductors, Conduits and Insulators:—

Pipe Insulator, G E. Dixon, Chicago, Ill., 481,899. Filed Mar. 1, 1892.

Conduit for Electric Conductors, A. Noll, Mt. Vernon, N. Y., 481,912. Filed Aug. 28, 1892.

Consists of metallic tube sections enclosed in coverings of insulated material, there being tubular insulated material forming the connection between each tube section.

Conduit for Electric Conductors, A. Noll, Mt. Vernon, N. Y., 481,913. Filed April 28, 1892.

Similar to 481,912.

Electric Circuit Connection, A. Noll, Mt. Vernon, N. Y., 481,914. Filed Apr. 28, 1892.

Employs tubular metallic conduits enclosed in insulated material junction boxes and metallic clips for receiving the ends of the conduits, and electric connections to such clips.

Distribution:—

Electric Lighting System, P. Cravath, Whitewater, Wis., 481,785. Filed May 31, 1892.

Employs a main circuit leading from the source of energy, a series of branch circuits each containing lamps, and a multiple switch between the main and branches by means of which the number of branch circuits in use is limited.

System of Electric Lighting, E. Huber, New York, N. Y., 481,904. Filed Oct. 7, 1891.

Relates to a system of distributing electric power throughout a system of light or motor circuits in such a way that the energy used up in the circuits is reduced to a minimum with a maximum effect.

Dynamos and Motors:—

Electric Fan, F. H. Beers, Newark, N. J., 481,646. Filed Feb. 26, 1892.

Claim 1 follows:

An electric fan having the blades attached to a revolving shell, encompassing the driving motor.

Electric Motor or Dynamo-Electric Machine, R. Lundell, Brooklyn, N. Y., 481,701, Filed Mar. 14, 1892.

Claim 1 follows:

An electric motor having a rotary armature and two overlapping field magnet poles all surrounded by a single field magnet coil,

Electric Motor and Regulating Device therefor, F. J. Sprague, New York, 481,739. Filed Apr. 29, 1889.

Employs two regulating commutators connected in multiple arc, each provided with contacts and circuits for varying the mechanical effects of the motor.

Device for Removing Armatures, S. H. Sharpsteen, Honesdale, Pa., 481,833, Filed May 6, 1891.

Consists of a track extending between the field magnets of the dynamo and two connected hangers adapted to travel upon the track and to engage with the armature shaft.

Dynamo-Electric Machine, W. S. Andrews, New York, and T. Spencer, Philadelphia, Pa.; reissue, 11,266 Filed July 11, 1892.

Claim 1 follows:

In a dynamo electric machine, the combination of the armature, the generating coils thereon, the field magnet and the external stationary coils supported upon said field magnet and wound so as to oppose the magnetizing effect on the armature core of said generating coils.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, W. J. Engledue, Byfleet, Eng., 481,664. Filed Mar. 23, 1892.

A reversible galvanic battery having a liquid-tight case and a locking device therefor.

Lamps and Appurtenances:

Duplex Arc Lamp, C. E. Scribner, Chicago, Ill., 481,677. Filed July 3, 1888.

Employs a single electromagnetic device for controlling a cut-out with its coil included in circuit, with one set of carbons and its armature and back stop in circuit with the other set.

Extension Chandelier, F. Overholt, Harlan, Iowa, 481,814. Filed May 31, 1892.

Measurement:—

Voltameter, F. A. La Roche, Ph., 481,573. Filed Sept. 1, 1891.

Operated by means of repulsion between two electromagnet cores magnetized by the passage of the current to be measured.

Miscellaneous:—

Apparatus Generating Ozone, C. C. Sharp, Chicago, Ill., 481,676. Filed Sept. 18, 1891.

Consists in applying one terminal of the generator to the body, maintaining the other terminal out of contact with the body, generating ozone at the non-conducting terminal and closing the circuit between the ozone generating terminal and the body by the current of ozonized air.

Method of and Apparatus for Extracting Gold and Silver from their Ores, J. W. Aylsworth, Orange, N. J., and A. C. Payne, Elizabeth, N. J., 481,683. Filed July 3, 1891.

Electric Cigar Lighting Lamp, W. J. Eastman, Waterville, N. Y., 481,692. Filed Feb. 8, 1892.

Electrically Driven Machinery for Cutting Coal. L. B. Atkinson and C. W. Atkinson, London, Eng., 481,775. Filed Aug. 18, 1891.

Employs a revolving ring carrying the cutting tools and having beveled geared teeth in combination with two rigid bearing plates covering the beveled teeth and between which the tool ring is journaled.

Electrically Controlled Stop Motion for Knitting Machines, V. S. Clute, Cohoes, N. Y., 481,726. Filed Oct. 28, 1891.

Rheostat, C. E. Carpenter, Minneapolis, Minn., 481,781. Filed Feb. 18, 1891.

Employs a rib base plate provided with a coating of enamel in which are embedded the resistance coils.

Electric Central Clock, N. Prokhoroff, Kiev, Russia, 481,916. Filed Sept. 4, 1891.

Railways and Appliances:—

Trolley Carriage for Conduits, S. L. Platt, Elgin, Ill., 481,817. Filed June 18, 1891.

Consists of a wheeled carriage adapted to be engaged by the car hanger and a contact wheel journaled in spring pressed bearings held in the carriage.

Magnetic Brake, A. de Bovet, Paris, France, 481,842. Filed Oct. 24, 1891.

Electric Railway, R. M. Hunter, Philadelphia, Pa., 481,905. Filed Sept, 21, 1891.

Employs a slotted conduit and current-collecting device, having a rearwardly extending pivoted arm making connection with the under side of the conductor.

Switches and Cut-Outs:—

Lightning Arrester Cut-Out, J. P. Freeman, Washington, D. C., 481,617. Filed Dec. 24, 1891.

Employs a magnetic needle alternately opening and closing the connection between the main line and the ground.

Ceiling Rosette Cut-Out, J. Pass and A. P. Seymour, Syracuse, N. Y., 481,-624. Filed Mar. 21, 1892.

Has for its object to simplify and cheapen the construction of cut-outs, etc., and provides means for the renewal of the fuse without the necessity of detaching any of the parts.

Safety Attachment for Electric Conductors, R. Furgang, Boston, Mass., 481,665. Filed Jan. 18, 1892.

An automatic cut-out for overhead trolley systems.

Safety Attachment for Electric Conducting Wires, R. Furgang, Boston, Mass., 481,666. Filed Jan. 25, 1892.

Similar in its object to 481,665.

Telephones and Apparatus:—

Multiple Switchboard Telephone Exchange System, C. E. Scribner, Chicago, Ill., 481,678. Filed Nov. 22, 1889.

Invention relates to bridging the annunciator across the two sides of the metallic circuit and to a switch in the circuit of the test battery; the circuits and connections being so arranged that when a plug is lifted the test battery will be connected to indicate the busy test.

Telephone Exchange, C. E. Scribner, Chicago, Ill., 481,679. Filed Nov. 16, 1891.

Employs branch circuits each including a retardation coil and a set of plugs with double stranded cords for each branch circuit and a clearing-out annunciator and condenser in a bridge wire between the strand of each set of cords.

System of Telephony, Elihu Thomson, Swampscott, Mass., 481,878. Filed Feb. 15, 1892.

Employs an alternating current of such low rate of alternation as not seriously to interfere with speech, in place of a continuous current.

Coin Signal Sounding Device, C. W. Holbrook, Windsor Locks, Conn., 481,903. Filed Nov. 28, 1890.

A sounding device for "nickel in the slot" telephones.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

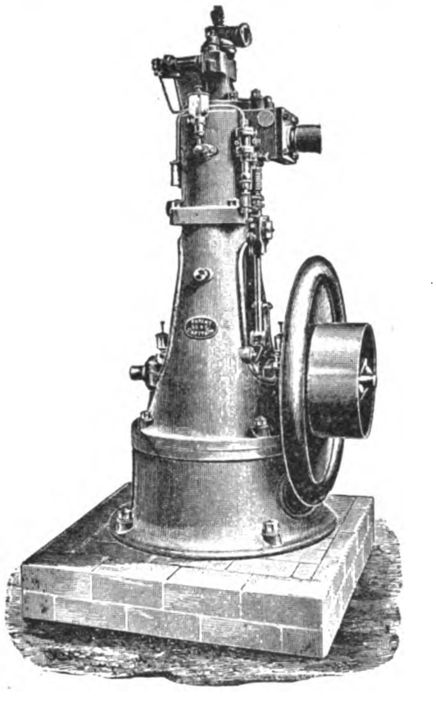
Advertising is rapid transit between buyer and seller.

THE GROB PETROLEUM ENGINE FOR ELECTRIC LIGHTING.

CONSIDERING the extent to which electric lighting increases every year, it may be of some interest to learn of a new type of engine which, through its special qualities, is rapidly coming to the front to drive dynamos.

The Grob engine is operated by ordinary petroleum, and has numerous advantages, particularly in regard to its application as an electric lighting engine.

The engine, which is illustrated in the accompanying engraving, is of comparatively small size, and therefore requires very little floor space, and is especially adapted for private residences and shops. Although being exceptionally light, so that it may be set up anywhere without special foundations, it is of solid and simple construction and massively and neatly built. The regulation is effected automatically, and in a very economical way.



THE GROB PETROLEUM ENGINE.

The motor does not require any special attendance, and is absolutely safe.

Special attention may be called to two important advantages of this motor; the easy operation without any strain and the quiet running, which both make this engine appropriate for using it in private houses as well as in other places, where vibration is not permissible. As the motor is able to work without belt, it is as a rule directly attached to the dynamo. Another important advantage is the fact that no licensed engineer is required to take care of the engine.

The cylinder is kept very cool with a small supply of water by application of a novel ventilator-refrigerator.

The engine, as constructed by J. M. Grob, of Liepzig, varies from 1 to 10 h. p; the dimensions of the 4 h. p. machine are as follows:

Height...	5 feet 10 inches;	diameter of pulley,	12 inches.
Breadth...	3 " 10 "	breadth "	5 "
Depth.....	3 " 7 "	number of turns per min.,	300

The weight of the whole motor, including all spare parts and packing, is about 1,980 lbs. The running expenses are exceptionally small and depend naturally on the price of petroleum. Based on a price of 10 cents per gallon, these expenses per 1 h. p. per hour amount to ¾ cent.

The engine will, in all probability, be exhibited at the World's Columbian Exposition at Chicago, and full information regarding it can be obtained from Mr. Maximilian Mintz, the agent for it in this country.

THE DARKY AND THE SOCKET.

MR. L. S. GREENSFELDER, vice-president of the Ries Electric Specialty Company, of Baltimore, Md., relates an amusing incident which occurred a few weeks ago. While sitting in the lobby of one of the principal hotels in the South, where the incandescent light was directly over the desk, at which he was writing, he quietly slipped a Ries regulating socket, which he had attached to a plug, into the old-time socket which was in use. He then called the porter, and told him to "please turn that light down a little, it is too bright and hurts my eyes." The colored porter smiled in delight and answered—"Boss, you ain't up to the times, dat ain't no gas light, dat is 'lectricity! and you can't turn it down, like gas." Mr. Greensfelder then politely said: "Coon, you are crazy, why of course you can turn it down," and no sooner said than done, Mr. G. arose and turned the key of the Ries socket down a peg or two and had a very nice light to suit his eyes. When the colored porter saw this, he said: "Look yar, boss, is you a magic man, or is dat a new kind 'lectricity?" Mr. G. then explained the new device. The colored porter smiled and said, "Look yar boss, I is going to make some money out 'a dat, I gone to go and get the head waiter, and bet him I can turn dat light down like gas. He of course will take the bet and I will take his money." Whereupon the porter silently went to look up the poor head waiter. Now comes the fun. While the porter was gone, Mr. Greensfelder withdrew the Ries regulating socket and plug from the old-time socket, putting them in his pocket, and replaced the lamp in the old socket which was in regular use at the hotel. In a few minutes the porter strutted in with his innocent prey (as he thought), the head waiter. "Look yar, Silas, I bets you forty cents I can turn dat 'lectric light down same as gas!" Whereupon the head waiter said, "Mose, you is gone crazy." "No, sir, I is not crazy, put up your forty cents and I shows you if I is crazy." The head waiter felt that he had a snap and put up his forty cents. Whereupon Mose tried to turn the light down as Mr. Greensfelder had done with the Ries regulating socket, and to his utter dismay, he of course turned it out every time; as nothing else can be done with the old-time sockets. Well, he tried time andtime again, but with no better results. He then turned about six shades whiter, and said, "Silas, I done lose de money. I guess dat man (meaning Mr. Greensfelder) only mesmerize me before, and make me believe I see him turn it down." Mr. G. then states that he quietly pulled the lamp out of the old socket, while the two colored gentlemen were arguing, and slipped his plug and Ries regulating socket again into the old socket, and the slick waiter was asked if he would bet again. He said, "Why, boss, dat is a snap." Mr. G. said, "Put up your money, Silas." When Mr. G. slowly with the aid of the regulating socket, turned the light up and down; poor Silas looked in dismay, and said to the little crowd which had gathered, "Gem'men, I'se done up, no tellin' what 'lectricity is gone a do for this world yet."

This little incident, however, caused the hotel proprietor to adopt the Ries regulating sockets throughout his house, he stating at the same time, that it was exactly what he had long been awaiting. Thus ended a little joke, by making a very nice sale.

THE BOYNTON BICYCLE RAILROAD.

AT the annual meeting of the Boynton Bicycle Railroad, the following board of directors was elected: Dr. James B. Bell, George Haseltine, D. C. Reusch, E. M. Boynton, William A. Stephens, David Wallace, W. H. Boynton, James D. White, C. A. Varney, F. H. Osgood, I. B. Watkins, H. W. Mawhinney, E. L. Sanborn, I. B. Newcombe, R. D. Evans, George Hagerman, W. H. Thurber, F. W. Dunton, M. C. Baker, O. M. Wentworth and Gen. O. O. Howard.

E. Moody Boynton was re-elected president and treasurer, and the other officers chosen were Dr. James B. Bell and F. H. Osgood, vice-presidents; W. H. Boynton, secretary, and D. C. Reusch, assistant secretary.

President Boynton in his report said that during the year patents had been obtained for seven inventions that will be used by the road, and among them were one for an electric locomotive and others for bicycle passenger and palace coaches. A general electric company was formed during the year with a capital stock of $5,000,000 under the control of the bicycle company and with the same officers.

The object of this company is to furnish this system of road with electricity as a motive power. The report further showed that during the year several companies had obtained charters to operate roads of this character in different parts of the country. The president assured the stockholders of the ultimate success of the principle of locomotion which this company is endeavoring to introduce.

One of the roads referred to is between Brooklyn and Bellport, L. I., and the other is between Aurora, Ill., and Chicago.

PURITY OIL FILTER MANUFACTURING COMPANY.

THE summer dull season has no terror for Mr. Albert C. Darragh, the general manager of the Purity Oil Filter Manufacturing Company of Pittsburgh, Pa. Mr. Darragh reports the following list of people to whom, among others, he has made sales during the month of August alone:

Homestake Mining Co., Lead City, S. Dak.; Tennessee Manufacturing Co., Nashville, Tenn.; Union Mill Co., Nashville, Tenn.; House of Refuge, Glens Mills, Pa.; E. H. Kellogg & Co., New York City; Farmers' Union and Milling Co., Stockton, Cal.; F. & R. Lazarus & Co., Columbus, Ohio; Southern Pacific Railway Co. Shops, Sacramento, Cal.; Victoria Brewing & Ice Co., Victoria, B. C.; Alaska Treadwell Gold Mining Co., Alaska; Leland Stanford, Jr., University, Mayfield, Cal.; Santa Cruz Electric Light & Power Co., Santa Cruz, Cal.; Mt. Pleasant (Pa.) Electric Light Co.; T. H. International Electric Co., London, Eng.

The success of the Purity Oil Filter Manufacturing Company, and the satisfaction given by its Ideal steam oil refiner can perhaps be no better shown than by the increasing number of voluntary testimonial letters being received by the company. Among recent letters of this nature is the following:

DOYLESTOWN, PA., August 18, 1892.

PURITY OIL FILTER MANUFACTURING Co.,
Pittsburgh, Pa.

Gentlemen.—We are very much pleased with the Ideal steam oil refiner purchased of you. It does all you claim for it.

Yours truly,
(Signed) JOHN YARDLEY,
Secretary Doylestown Electric Co.

GRAMME ARMATURES IN STATION GENERATORS.

WITH regard to Mr. L. E. Marple's article in THE ELECTRICAL ENGINEER of August 31 on "Some Advantages of Gramme Armatures in Station Generators," Mr. F. A. Scheffler, the superintendent of the factory of the Brush Electric Co., writes us:

"This article bears out fully the operation of Gramme ring armatures, such as have been used by the Brush Company ever since its existence. As this company has never made any other kind of an armature the results obtained by them with the Gramme armature show conclusively that it is only because the armature can be and is so thoroughly ventilated as to produce a long life in the bobbins of armatures. There are hundreds of armatures in daily use of this type which were made ten years ago and are still running with the same winding on them. I know of no other type of armature which can show such a record as this. All generators manufactured by this company also have this form of an armature. The bobbins on same have very few layers of wire, and are, therefore, easily repaired should an accident occur. The fact of there being very little wire on the armatures per bobbin also permits quick radiation of heat, and the life of the insulation is greatly prolonged thereby."

Mr. H. F. Parshall, of the Thomson-Houston Electric Co.'s factory, at Lynn, writes:

"The remarks of Mr. Marple do not apply to the style of drum winding at present used by this company. The drum armatures with the bifurcated end conductors are more easily ventilated, easier to repair and less liable to give trouble than the Gramme type of armature. The use of the bifurcated end conductor makes it possible to replace any particular bar without disturbing any other. It also leaves these conductors thoroughly ventilated on both sides since there is a good-sized air duct between the end conductors and the core of the armature. The core of the armature is ventilated by means of several ducts arranged in planes perpendicular to the axis of the armature. By experiment it has been found that the ventilating capacity of an armature of this construction has been doubled over that of the ordinary Gramme construction. I should say, therefore, that qualifying terms should be used in this article to distinguish between the new and old types of drum winding."

NEW YORK ELECTRICAL ENGINEERING CO.

THE contract for the construction of four miles of electric railway in Montgomery, Ala., has been awarded to the New York Electrical Engineering Company of 206 Broadway, New York City. Westinghouse apparatus will be used. The New York Electrical Engineering Company's contract is for the complete installation and equipment of the road.

AN OLD COMPANY IN A NEW HOME.

THE STEUBEN LAMP WORKS, formerly of Hornellsville, N. Y., are now settled in their new factory at Canisteo, N. Y. The new home of this company is a modern building with a frontage of 96 x 80 feet, and has an isolated flashing house and storeroom. The main building is three stories high, with unexcelled light and ventilation. They have just placed in position three large steel boilers of the Erie type, and two 75 h. p. high speed automatic engines and have a capacity of 1,500 lamps per day. The company are in a position to make prompt shipments of all orders with which they are favored. They are, also, not only willing but anxious to send free sample lamps to all responsible persons desiring them.

NEW YORK NOTES.

THE BISHOP GUTTA-PERCHA CO., 420-426 East Twenty-fifth street, this city, have just issued a new illustrated catalogue and price list of their insulated wires and cables for all classes and conditions of service. The record of the company is a long and honorable one. They started in 1847, and yet some of their earliest work stands to this time, just as some of their work of to-day promises to be in use forty five-years hence. Not only does the catalogue contain all the necessary data as to Bishop, Balata, etc., but it embodies a variety of useful information. It also includes a number of striking testimonials as to the high qualities of these wires and cables in submarine, overhead, central station, underground and all other branches of work. There can be no question that as regards, for example, high tension underground work, the Bishop cables have stood up most remarkably in New York, Philadelphia and other cities.

MR. GEORGE A. FORD, of the Ford-Washburne Storelectro Co., of Cleveland, O., has been spending the week in New York City in connection with storage battery business. The remarkable results shown by their battery have called attention to it very generally. Its robust construction, as evidenced by an ability to give up 300 and 400 amperes on short circuit a number of times without any injury whatsoever, is regarded as opening up a new and better era in electric storage traction. It is claimed that the battery does what was impossible with the old plate, by virtue of its great capacity and its remarkable endurance, and that it is the desideratum in its field.

THE ELMIRA ELECTRIC ILLUMINATING CO. are building a new plant at Elmira, N. Y., and have placed the contract for the iron roofs with the Berlin Iron Bridge Co., of East Berlin, Conn. The dynamo-room will be 66 feet wide by 177 feet long, covered with the Berlin Company's patent anti-condensation corrugated iron roofing—the floor space being controlled by a ten-ton traveling crane. The boiler-room will adjoin the dynamo-room and will be 82 feet wide by 75 feet long. When completed, this will be one of the finest electric light plants in New York State.

THE SPERRY ELECTRIC CO. have opened offices at 29 Broadway to introduce an electric motor and trolley system which is said to have given remarkably good results at Youngstown, O., where it has been in operation for nearly a year. The car has but one motor, flexibly suspended, quite noiseless, and there are various improved devices in the trolley arrangements.

MR. EDWIN G. REYNOLDS, until recently the steward of the New York Electric Club, has assumed charge of the Eastern office of the *Street Railway Gazette*, in the Electrical Exchange Building, Liberty street. He will represent that paper in the East, and needs no introduction to electrical circles.

MR. THOMAS ROBINS, JR., the patentee of a novel form of conveyor belt for concentrating plants, is now established at 120 Liberty street, this city. Some of the belts invented and sold by Mr. Robins have been subjected to the severest tests, and all, so far as heard from, are giving perfect satisfaction.

P. CLAUS & CO., the electrical engineers and contractors, dynamo builders, etc., have equipped a factory for constructing their dynamos and motors, etc., at 357 West Fortieth street, where they will also have their offices. They are very busy, and are getting plenty of new orders.

DR. SCHUYLER S. WHEELER and his wife have recently been touring in the north of Germany, and it will be a great relief to their many friends to know that they have been heard from in Switzerland and are well. They start at once for home, and will receive a warm welcome.

NEWTON L. SCHLOSS AND G. J. SCOTT of the Ries Electric Specialty Co. were New York visitors last week and favored this office with a call.

CANADIAN NOTES.

THE CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, has acquired the business and interests in Canada of the Edison General Electric Company, the Thomson-Houston International Electric Company, and the Toronto Construction and Electrical Supply Company. The Canadian General Electric Company will now have control of the entire Edison systems, including the Edison factory at Peterboro, the Wood arc light system and the systems controlled in Canada by the Thomson-Houston International Electric Company. To meet the extensive requirements of such a consolidation, this company has applied to the Canadian Parliament for authority to increase its capital from $1,000,000 to $2,000,000.

HARRISBURG IDEAL ENGINES.

The Harrisburg Ide and Ideal engines built by the Harrisburg Foundry and Machine Works, Harrisburg, Pa., are in demand among the electrical and manufacturing interests of the country. The following engines are being prepared for shipment in the next few days: One 16 x 16, one 13 x 12, one 10 x 10 Ideals for Chillicothe Electric Railway; four 12 x 12 Ideals to be used in connection with the Wadell-Entz Electric Co., in New York; three 12 x 18 standard Ide engines for Hartford, Conn.; one 11 x 12 and one 7 x 10 for the Racquet Club, New York; two 16 x 16 Ideals for a New York City apartment house; one 14 x 20 standard Ide for Perth Amboy, N. J.; one 9 and 15 x 12 Ideal compounds for California; two 9 and 15 x 12 Ideal compounds for the Pennsylvania State Insane Hospital; one 9 and 15 x 12 for the Mt. Pleasant Steam Printery. These engines are all for shipment in the next 10 days or two weeks.

They are also just shipping ten 100 h. p. steel return tubular boilers for a hollow ware company. These boilers are equipped with the Weitmyer furnace, which will increase their efficiency at least 10 per cent. The company have just furnished ten 100 h. p. boilers for the Central Iron Co., Harrisburg, equipped with the same furnace. They are also setting two large boilers for the Alexandria Street Railway Company. Besides these orders, the company have work ahead for some three months and are compelled to work night and day.

WESTERN NOTES.

The "Electra."—On Saturday evening, Aug. 27, Gen. C. H. Barney, the manager of the Electric Launch and Navigation Compady, of New York, invited the representatives of the electrical press of Chicago to take an evening sail on the lagoons of the World's Columbian Exposition on the electric launch "Electra." Several ladies were among the party, and the "Electra" performed its work to perfection, showing the superiority of electricity as a motive power for launches, and every one was charmed with the boat. During the two hours' sail light refreshments were served, and a most enjoyable evening was spent by all.

The General Electric Company have recently secured a contract, against keen competition, whereby they are to supply to the Cass Avenue Street Railway Company, of St. Louis, Mo., 85 cars, each equipped with two 25 h p. motors of the well-known Standard W. P. type, three 800 h. p. direct-coupled railway generators at a speed of about 90 revolutions. By this purchase by the Cass Avenue Company, the entire system of electrical railroads in St. Louis is now solely equipped with apparatus manufactured by the General Electric Company.

The Midland Electric Works, of which Mr. Ray Griggs is president, and Mr. C. F. Sammis, secretary and treasurer, are doing a general electrical construction and repair business at No. 224 East Washington street, Chicago. They also make a specialty of model and experimental work of electrical devices and machinery of all kinds, and have excellent facilities for giving the best satisfaction in work of this class.

The Chicago and St. Louis Electric Railroad Co., which proposes to operate a road between the two cities with 15 ton cars at a speed of 100 miles an hour, has issued an elaborately illustrated folder, giving pictures of the proposed road, terminal depots, and apparatus. This company's bold project has already been described in The Electrical Engineer, and its progress will be watched with intense interest.

The Electrical Appliance Company have just received their first consignment of security cleats which are meeting with ready sale. The Security cleat and Security insulator are the latest specialities in the direction of higher grade electrical construction, and will receive a hearty welcome from every electrical engineer who is looking for improvement in the present methods of electrical installation.

George A. McKinlock, treasurer of the Central Electric Company, nothing daunted by cholera reports, has gone abroad for a month on his vacation and will visit Ireland and Scotland, besides going to London and Paris in a semi-business capacity for his company.

Prof. G. D Shepardson, of the electrical engineering department of the University of Minnesota, was married, on August 31, at Kings Mills, Ohio, to Miss Harriet Bowker King, and has now returned with his wife to Minneapolis to resume his work at the university.

Mr. R. Fleming, electrical engineer with the Rockford Electric Manufacturing Company, of Rockford, Ill., visited Chicago during the past week, and found time to drop in at the Western office of The Electrical Engineer.

The Central Electric Company are doing a very brisk business in all lines of general electrical supplies and Okonite wire is having a run as usual.

The Acorn Lamp.—The high grade that has been maintained by the Sunbeam Incandescent Lamp Company in their Sunbeam lamps has been shown very conclusively by the large and increasing business the company are doing. Attention is called to the announcement in our advertising columns this week of their "Acorn" lamp made in all colors for display lighting.

NEW ENGLAND NOTES.

S. C. Nightingale & Childs, of Boston, have recently furnished a quantity of their well-known Magnesia sectional covering to the Edison Electric Illuminating Company of Boston, for a rather novel purpose. The Edison Company had occasion to use insulated cables underneath one of the many bridges crossing one of the steam railroads of Boston. These cables connecting their regular underground system on either end of the bridge, were exposed to the escaping steam and hot gases from locomotives which are in the habit of standing directly under the bridge, and were in danger of having the insulation entirely melted or burned off. Recently the cables were all covered with Magnesia sectional covering, which has completely obviated all danger, and thoroughly prevents any of the steam or hot gases from coming in contact with the insulation.

The Beacon Vacuum Pump and Electrical Company, of Boston, are calling the attention of the trade to their new and revised price list recently issued. The demand for the Beacon lamp has been constantly increasing all summer, and a recent visit to their factory showed that they were manufacturing as many lamps as their floor space would allow, and presented a very busy and interesting scene. It is expected that within a very few weeks much larger facilities will be procured, and the Beacon lamp will be manufactured in even larger numbers than before.

The Shawmut Fuse Wire Company, of Boston, have issued a neat little catalogue of their manufactures, calling the attention of electrical dealers to their tested fuse wire and links, and presenting in an interesting way a lot of valuable information regarding the fusing point of fuse wires. The pamphlet is well illustrated and brings out the necessity for using an accurately tested fuse wire for good and safe work. It will be found very useful to all constructing electrical engineers as well as central station managers and electrical supply dealers.

The Bradbury-Stone Storage Battery Company, of Lowell, Mass., are extremely busy with their fall business, and are receiving large orders for their well-known storage battery for use in phonograph, lighting, signaling and all kinds of work where electricity is required. Their battery appears to have given immense satisfaction in phonograph work, and they are in receipt of many letters from users giving the warmest kind of unsolicited testimonials, of which they may be justly proud.

The Westinghouse Electric and Manufacturing Company, through their Boston office, have closed a contract for the electric equipment of the street railway of the Sanford Electric Railway Company, of Sanford, Me., the railroad to be in operation by October 20th, 1892. The equipment consists of one 100 h. p. generator, two passenger cars and one electric locomotive for hauling freight.

Messrs. Brown & Sharpe's illustrated catalogue for 1892 contains about 250 pages of descriptive matter concerning their well-known specialties. The book is of a convenient size, 5¼ by 3¼ inches, and as usual, contains a great quantity of valuable information on mechanical and engineering subjects.

PHILADELPHIA NOTES.

The Helios Electric Co. recently incorporated under the laws of Pennsylvania for the manufacture of electrical apparatus, supplies and appliances, is composed of some of the best-known electrical men in the East. Its incorporators are: D. C. Spruance, Frank S. Marr, Thomas Spencer, John C. Corbit, Jr., and Thomas J. Johnson. They will start in business with a well equipped factory occupying the entire sixth floor of the new Clark & Dunlap Building, 13th and Filbert streets. It is understood that they will make a specialty of a new arc lamp.

Mr. C. L. Crosby, well known in electrical circles, has associated himself with the Commonwealth Electric Co. He will devote most of his time to soliciting and outside work.

The Gibson Gas Fixture Co. has, in order to accommodate its rapidly increasing Western trade, established a Western branch at 171 South Canal street, Chicago, Ill.

☞ ***Departmental items of Electric Light Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.***

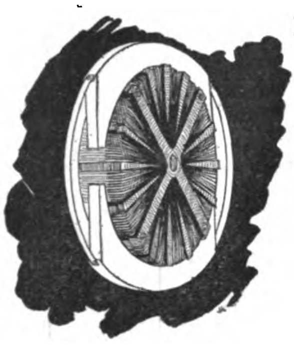
THE
Electrical Engineer.

VOL. XIV. SEPTEMBER 21, 1892. No. 229.

THE GENESIS OF THE MODERN DYNAMO: ANTONIO PACINOTTI.—I.

BY

Franklin Leonard Pope



OF the dynamo-electric machine, using the term in its broadest signification, as defined by Silvanus Thompson—that of a machine for converting energy in the form of mechanical power into energy in the form of electric currents, or *vice versa*, by the operation of causing conductors to rotate in a magnetic field[1]—it is not too much to say that it seems inevitably destined in the future to occupy a position in the industrial world, certainly not less important, possibly far more important, than does the steam engine at the present day. The historic experiments of Faraday, interpreted in the light of the mathematical researches of Maxwell, and still further elaborated by the persevering and painstaking investigations of Crookes, have proven almost to a demonstration that the whole vast universe is filled with an all-pervading ether, and that the phenomena of light and heat, electricity and magnetism, force and motion, and possibly even matter itself, are but the protean manifestations of this infinite essence. If it is true, as the researches of Crookes apparently show, that the molecular forces inherent in the ethereal fluid are incomparably greater than any of those which have as yet been subjected by man, so that perhaps millions of horse-power may be contained within the circumscribed limits of an ordinary room, the time may come, nay almost certainly will come, when we shall discover—as Tesla expresses it—how to "hook our machinery on to the machinery of nature."[2] Should that day dawn upon us, it may well be that the steam-engine and the water-wheel will be relegated to the limbo of historical curiosities, while the dynamo-electric machine will reign supreme as the sole immediate source of power for industrial uses throughout the world.

While the dynamo-electric machine, as it exists to-day—perhaps in respect to its economic efficiency, the highest type of machine ever devised by the mind of man—is the result of a well-defined and continuous process of evolution, almost every step of which has been made within the memory of men of middle age now living, yet when we study attentively the history of this process of evolution, we shall find, as in all similar instances, that among the many successive advances of lesser importance, there are a certain few which the progress of events has demonstrated to have been radical and fruitful innovations upon preexisting practice, and which form, as it were, conspicuous landmarks of progress along the path of invention. First and foremost among these, beyond all question, is the discovery of magneto-electric induction, first made known to the world in the autumn of 1831 by Faraday,[3] but as later researches have shown, independently discovered by Henry at a somewhat earlier date.[4] This was almost immediately followed by the construction of the well-known alternating magneto-electric machine of Pixii,[5] to which the same inventor soon applied a commutator for rectifying or "straightening" the alternate currents.[6] A host of subsequent inventors labored zealously upon this machine, vastly improving it in many of its details, but for a long time developing no new principle of importance. In 1848, Brett made the important and fruitful suggestion that the magnetic intensity of the permanent field-magnets might be augmented by surrounding them with helices of insulated wire through which the current developed in the armature was made to pass.[7] For many years, however, this conception, which we now know to have been the virtual key to the whole problem, lay dormant,

Antonio Pacinotti

(From a Photograph taken in 1882, by Alinari Brothers, Florence.)

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[1] SILVANUS P. THOMPSON. *Dynamo-Electric Machinery* (4th Ed.), p. 1.

[2] J. E. H. GORDON. *Nature's Immeasurable Unused Force.* ELECTRICAL ENGINEER, xiii, 340; F. L. POPE. *Energy by the Roomful*, ibid, xiii, 388.

[3] FARADAY. *Experimental Researches*, i, 7.

[4] MARY A. HENRY. *America's Part in the Discovery of Magneto-Electricity.* ELECTRICAL ENGINEER, xiii, 27, *et seq.*

[5] *Ann. Chim. Phys.*, i, 322 (1832).

[6] *Ann. Chim. Phys.*, ii, 76 (1832). The simple two-section commutator appears to have been devised by Sturgeon. *Annals of Electricity*, ii, 1 (1838). See also STURGEON'S *Scientific Researches*, 252; *Phil. Mag.*, vii, 231 (1835).

[7] Specification of British Patent, No. 12,054, of 1848.

and as a necessary consequence, the magneto-electric machine remained little more than a philosopher's toy. In chronological order, the next important step in advance was made by Pacinotti, in the machine constructed by him at Pisa, of which the first description was published in 1864, in which the armature coils were for the first time arranged in parallel in a closed circuit, for the production of a continuous uni-direction current.

Next, in progress of time, rapidly followed the rediscovery and practical application, in 1866, of the principle of auto-excitation first suggested by Brett, but worked out independently and almost simultaneously by Farmer in the United States[8], Varley[9] and Wheatstone[10] in England, and Siemens in Germany[11], and finally the armature construction of Pacinotti—which had, meantime, been independently rediscovered and introduced by Gramme in France in 1871—and the self-excited field-magnets were combined in one machine by Hefner-Alteneck in Germany in 1872,[12] giving to the world the modern direct-current dynamo, with all its wonderful capabilities.

We can clearly see therefore, in the light of the knowledge of to-day, that the essential and fundamental discoveries, which converted the feeble and inefficient magneto-electric machine of the last generation, into the magnificent dynamo-electric machine of to-day, have been really but two in number; first, the endless winding of the armature coils, rendering possible the production of a continuous direct current, and second, the excitation of the field magnets by a current derived from the armature working in the self-same field produced by these magnets.

The story of the first of these achievements has, so far as the writer is aware, never been fully told. It is well worth the telling.

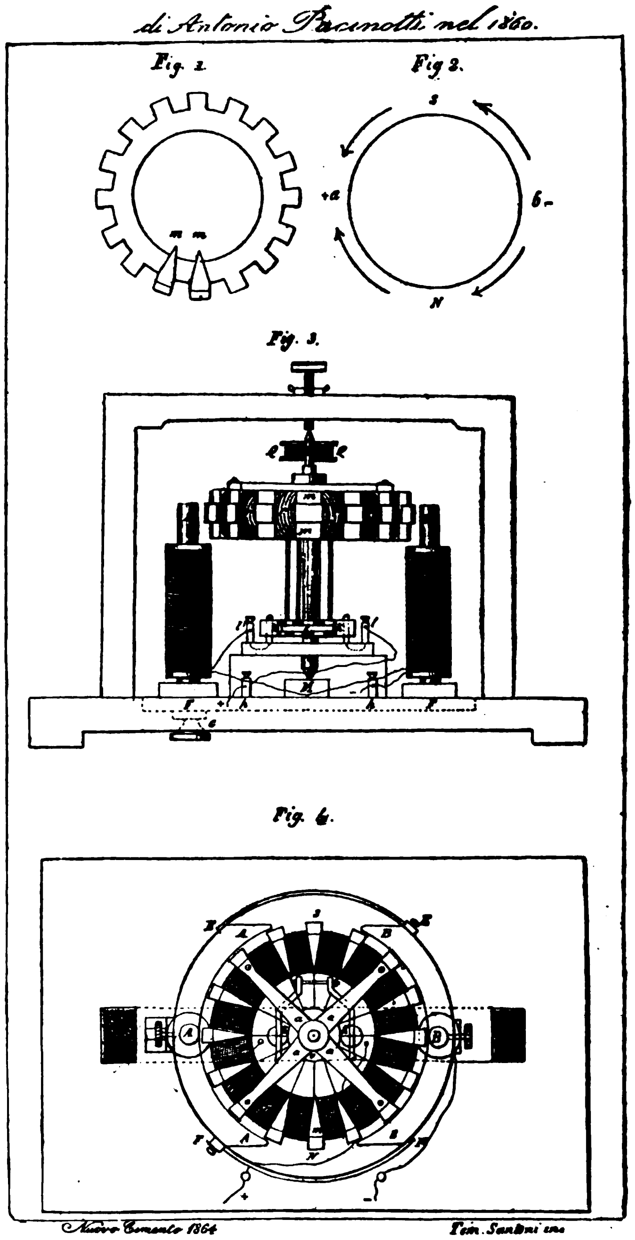
The University of the old Italian city of Pisa is remarkable, not merely for its venerable antiquity, but for the eminence which its scholars, by reason of their researches and discoveries, have attained in the annals of literature and science. In a church not far from the University is still to be seen the suspended lamp, the oscillations of which, according to tradition, served to place in the mind of the illustrious philosopher Galileo, the germ of the conception of the true relation and movements of the heavenly bodies. Near at hand, moreover, is the famed leaning tower of Pisa, which proved to be so singularly well adapted to his needs in the prosecution of his subsequent researches made with the aid of the pendulum.

It would seem eminently in accordance with the fitness of things, that the very locality renowned throughout the world as the scene of the labors of the illustrious founder of experimental philosophy, and the greatest of astronomers, of physicists and of mechanicians, should receive added lustre in the annals of physical science as the birthplace of the continuous current dynamo-electric machine.

In a scientific journal published in Pisa, under the title of *Il Nuovo Cimento*, there appeared in June, 1864, a remarkable article entitled "Descrizione di una Macchinetta Elettro-Magnetica; del Dott. Antonio Pacinotti" (Description of an Electromagnetic Machine of Dr. Antonio Pacinotti.) The historical importance of this communication justifies its reproduction in full, with copies of the original illustrations. We therefore present the following, which is a careful and accurate translation from the original:

In 1860 I had occasion to have a model of an electromagnetic machine of my invention constructed for the Cabinet of Technological Physics of the University of Pisa. This instrument I have now concluded to describe particularly, in order to make known a peculiar kind of electromagnet used in its construction. Besides its novelty, it seems to me suitable for obtaining greater regularity and constancy of action in such electromagnetic machines, while its form appears to be a convenient one for collecting all the induced currents of a magneto-electric machine.

In ordinary electromagnets, even when provided with a commutator, the magnetic poles always remain in the same position, while with the commutator attached to the electromagnet to be described, the poles may be made to move along in the iron subjected to magnetization. The form of the iron in this electromagnet is that of a circular ring. To facilitate a conception of the direction and mode of action of the magnetizing current, let us suppose a copper wire covered with silk wound around our iron ring, as follows: When the first layer of convolutions is completed, instead of continuing the helix by forming the second layer on top of the first, we close the metallic wire by soldering together the two ends. In this way we cover the iron ring with a closed insulated spiral having everywhere the same direction. Now, if we connect two points sufficiently far apart of the metallic wire of this helix with the two poles of a battery, the current will divide itself into two portions and will traverse the helix in parallel between the points of connection. The directions it assumes are such that the iron will become magnetized and present its poles where the current enters and leaves. The right line joining these poles may be called the magnetic axis. By changing the points of connection with the battery this axis may be made to assume any position whatever transverse to the iron



FAC-SIMILE OF ORIGINAL ILLUSTRATIONS ACCOMPANYING PACINOTTI'S DESCRIPTION.

(*From the Original Pamphlet*).

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8. *Proc. Literary and Phil. Society of Manchester*, vi, 107; N. S. KEITH. American edition of SCHELLEN's *Magneto and Dynamo-Electric Machines*, i, 112, 145. See also U. S. patent 161,874, of April 13, 1875.

9. C. and S. A. VARLEY, British patent 3394, of 1866, and 1755 of 1867.

10. *Proc. Royal Soc.*, xv, 369-72.

11. *Berliner Berichte*, Jan., 1867; *Proc. Royal Soc.*, xv, 367; *Phil. Mag.*, xxxiii, 469; *Pogg. Ann.*, cxxx, 332. See also British patent 261, of 1867.

12. SCHELLEN. *Magneto and Dynamo-Electric Machines* (Amer. Ed.), i, 303. See also British patent 2006, of 1873.

ring, which I would therefore call a *transverse electromagnet*. The two pieces of magnet placed at the extremities of the right line (in our machine the diameter) joining the points of entrance and exit of the battery current, may be considered as two opposing semi-circular electromagnets, with the poles of the same name together.

In order to construct on this principle the electromagnet with which I provided the little electromagnetic machine, I took a ring of turned iron fashioned like a gear-wheel with sixteen equal teeth, as indicated in Fig. 1. (See Plate IV.) This ring is braced by four brass radii (spokes), *a a a a*, Fig. 4, which unite it with the axle of the machine. Between the teeth little triangular prisms of wood, *m*, Figs. 1 and 4, leave depressions, in which I inserted as many well-insulated electro-dynamic helices or clews, made by winding silk-covered copper wire around them. In all these bobbins, some of which are marked *r* (Figs. 3, 4), the wire is wound in the same direction, and each one consists of nine turns. Every two consecutive bobbins, like *r r'*, are separated by an iron tooth of the wheel and by a triangular wooden prism, *m m* (Figs. 1, 3, 4). Passing from one bobbin to make the next, I left free a loop or stirrup of copper wire, which I fastened to the wooden separator, *m*. I then conducted all these loops, each of which is the end of one bobbin and the beginning of the next, towards the axle, *M M* (Fig. 3), of the wheel, causing them to pass through holes conveniently situated in a wooden collar on the same axle, and attaching each one to the commutator, *c* (Fig. 3), also centered on the same axle. This commutator consists of a small, low, box-wood cylinder, with two rows of mortises around the edges of its cylindrical surface. In these mortises are inserted sixteen bits of brass, eight above and eight below, arranged so as to alternate. Their surfaces are concentric with the wooden cylinder, a little projecting, and separated by the wood. In the representation, *c*, of the commutator, the brass pieces are indicated by the shaded spaces. To each of them is soldered a corresponding loop connecting two bobbins. In this wise all the bobbins are connected, each being united with the next by a conductor, of which one of the pieces of brass in the commutator forms a part. Connecting, then, two of these brass pieces with the poles of a battery by means of two metallic rollers, *k k* (Figs. 3, 4), the current dividing itself into two branches, will traverse the helix on both sides of the points where the loops separate which unite the two commutating parts, and the magnetic poles will appear in the iron ring at *N S*. Upon these poles, *N S*, act the poles of a fixed electromagnet, *A B*, and produce a rotation of the transverse electromagnet around its axis, *M M*; but, even when it is in motion, the poles continue to occupy the same position, *N S*, which corresponds to the connection with the battery.

This fixed electromagnet, as is shown in Figs. 3 and 4, consists of two iron cylinders, *A B*, joined together by an iron cross-piece, *F F*, to which one of them is screwed fast, while the other is secured in its place by a screw, *G*, placed beneath, which permits it to slide along a slot when it is desired to make the poles of the cylinders, *A B*, approach the teeth of the wheel or recede from them. The battery current, entering at the binding screw, *h*, passes through a metallic wire to the binding screw, *l*, thence to the roller, *k*, circulates through all the bobbins of the wheel, and returns through the binding screw, *l'*, whence it passes through another copper wire into the helix surrounding the cylinder *A*. Upon issuing from the latter it traverses the helix of the cylinder, *B*, and connects by means of another copper wire with the binding screw, *h'*.

I found it advantageous to attach to the two poles of the fixed electromagnet two soft iron armatures, *A A A*, *B B B*, each of which embraces more than one-third of the circumference of the wheel which forms the transverse electromagnet. They are placed quite near to the teeth of the latter, and are held together by means of brass braces, *E E*, *E E*, as is seen in the horizontal projection (Fig. 4). These armatures are not represented in the vertical projection (Fig. 3) of the machine, because they would have hidden the bobbins and the teeth of the wheel too much. The machine works even when the current passes through the circular electromagnet alone, but it has much less power than when the current passes through the fixed electromagnet also.

I made a few experiments to determine the mechanical work produced by the machine and the corresponding consumption in the battery.

These experiments were conducted according to the following method:

The shaft of the little electromagnetic machine carried a pulley, *Q Q* (Fig. 3), communicating with a rather large wheel by means of a cord, and causing it to turn when the machine was in motion. The axle of this wheel was horizontal and wound up a cord carrying a weight. At one end of the horizontal axle of this little windlass was a brake, which was made to bear down until the weight to be raised was almost sufficient to set in motion the whole apparatus, including the electromagnetic machine, not traversed by the current. With this arrangement, when the machine is set in motion, the mechanical work expended in overcoming friction is equal to that employed in raising the weight, and to obtain the total work performed by the electromagnetic machine we have only to double that obtained by multiplying the weight by the height to which it was raised. To find out the consumption in the battery necessary to produce the work thus determined, a voltameter of copper sulphate was inserted in the circuit, and the plates of copper were weighed before and after the experiment.

I will report the numbers obtained in one of these experiments with the transverse electromagnetic machine. This machine had a wheel thirteen centimetres in diameter, was set in motion by a battery of four small Bunsen cells, and raised a weight of 3.2812 kilogrammes, including estimated friction, to a height of 8.66 metres; the mechanical work was therefore 28.415 kilogrammetres. The positive copper of the voltameter lost 0.224 gramme, while the negative copper gained 0.235 gramme, so that the mean chemical work in the voltameter may be called 0.229 gramme. This number, multiplied by the ratio between the equivalents of zinc and copper, and by the number of cells of the battery, gives 0.951 as the weight of zinc consumed. Hence, to produce one kilogrammetre of mechanical work, 33 milligrammes of zinc were consumed in the battery. In another experiment, made with five cells, the consumption was 36 milligrammes per kilogrammetre. Although these results do not show the new model to be notably superior to other electromagnetic machines, they do not seem to me to be unfavorable, when it is considered that there exist in it defects of construction which do not occur in other machines of this kind. Among these, it should be noted that the commutator is made of brass and not well centered on the axle, so that the contact is not always sufficiently good.

The reasons which led me to construct an electromagnetic machine arranged as described, were the following: (1.) In the arrangement adopted, the current never ceases to circulate in the helices, and the machine does not move by a series of impulses succeeding each other more or less rapidly, but by a couple of forces which act continuously. (2.) The circular shape of the rotating magnet, assisted by the preceding mode of successive magnetization, gives regularity to the motion, and reduces the loss of *vis viva* in shocks and friction to a minimum. (3.) There is no attempt made to effect instantaneous magnetization and demagnetization of the iron in the electromagnet, which would be opposed by the extra currents and by the coercitive force, which we can never get rid of entirely in the iron; but it is required only that every portion of the iron in the transverse electromagnet, subjected continually to the proper electro-dynamic forces, shall pass successively through the different degrees of magnetization. (4.) The enlarged armatures of the stationary electromagnet embrace a considerable number of the teeth of the magnetic wheel upon which they act, and, therefore, do not cease to influence them so long as any magnetism remains in them. (5.) The sparks are increased in number, but much diminished in intensity, there being no strong extra currents on breaking the circuit, as the latter may remain continually closed. Only while the machine is in action is there a continuous induced current in a direction contrary to that of the battery current.

It seems to me that the value of this model may be increased by the fact that it may easily be converted from an electromagnetic to a magneto-electric machine with continuous current. If, instead of the electromagnet, *A B* (Figs. 3, 4), we substitute a permanent magnet, and cause the transverse electromagnet to rotate, we should have in fact a magneto-electric machine furnishing a continuous induced current always in the same direction. In order to find the most suitable points for tapping the commutator, in order to collect the induced current, we should observe that opposite poles are induced in the movable electromagnet at the extremities of the diameter presented to the poles of the stationary magnet. These poles, *N S*, maintain a fixed position even when the transverse electromagnet rotates on its axis. As regards the magnetism, and consequently the induced currents also, we may therefore consider, or suppose, that the bobbins of copper wire revolve around the circular magnet on which they are strung, and that the latter remains stationary. In order to study the induced currents developed in these bobbins, let us examine one of them in the various positions it may assume. Going from the *N* pole (Fig. 2) to the *S* pole, there will be developed a current in one direction until we reach the middle point, *a*, where the direction is reversed. Proceeding from *S* towards *N* until we come to the middle point, *b*, the currents will preserve the same direction they had between *a* and *S*; beyond *b* the direction will change again to that observed between *N* and *a*. Now, as all the bobbins are connected with each other, the electromotive forces in a given direction may be added together, and will give to the total current the arrangement indicated by the arrows in Fig. 2. In order to collect it, the most convenient positions will be at *a*, *b*; in other words, the commutator is tapped at right angles to the line of magnetism of the electromagnet. The induced current may have its direction changed by changing that of the rotation. When the commutator is tapped at the diameter corresponding to the line of magnetism, no current is obtained, though the electromagnet be in motion. On tapping it to one side of this diameter, the current obtained is in a direction contrary to that it would have had if the commutator had been tapped on the other side of this diameter.

To develop an induced current by the machine thus constructed, I brought near the magnetic wheel the opposite poles of two permanent magnets, or magnetized the stationary electromagnet it contained by means of a current, and then caused the transverse electromagnet to rotate on its axle. With both methods I obtained an induced current continuously flowing in the same direction, which indicated a moderate intensity in a galvanometer, even after passing through copper sulphate or water acidulated with sulphuric acid. It is evident that the second method cannot be convenient; but it remains easy to put a permanent magnet in the place of the temporary one, A F F B, and then the resulting magneto-electric machine will have the advantage of furnishing cumulative-induced currents, all in the same direction, without the necessity of mechanical appliances for separating them from others in opposite direction, or for making them conspire together. This model also shows very well that the electromagnetic is the opposite of the magneto-electric machine; in the former the current entering the binding screws, *l l'*, and circulating around the bobbins, produced motion of the wheel and mechanical work, while the latter applied mechanical work to make the wheel turn, and so obtained from the permanent magnet a current in the bobbins, which is conducted to the binding screws *l l'*, whence it may be introduced into any substance we desire to act upon.

The careful reader will note certain inconsistencies in the minor details of the above description. For example, it will be found in Fig. 1 that the contact-rollers are shown as having been placed opposite the respective poles of the stationary electromagnet, whereas, to produce an effective operation of the apparatus, they should of course have been placed in a plane at right-angles with a line joining these poles. An oversight of the draughtsman is also apparent in Fig. 2, in which the arrow between N and *b*, indicating the direction of one portion of the current, is made to point in the wrong direction, as a reference to the text clearly shows. In the actual machine, of which a careful drawing is given in Fig. 5, the contact-rollers will be seen to be in their proper angular position. The error first noted may perhaps have been due to an oversight on the part of the author, rendered explicable by the considerable length of time that had elapsed between the construction of the actual machine and the preparation of the description, some three or four years, or what is more probable, it may have been due to an accidental misplacement of the parts, which the draughtsman, from want of familiarity with the principle of the machine, failed to notice and to rectify.

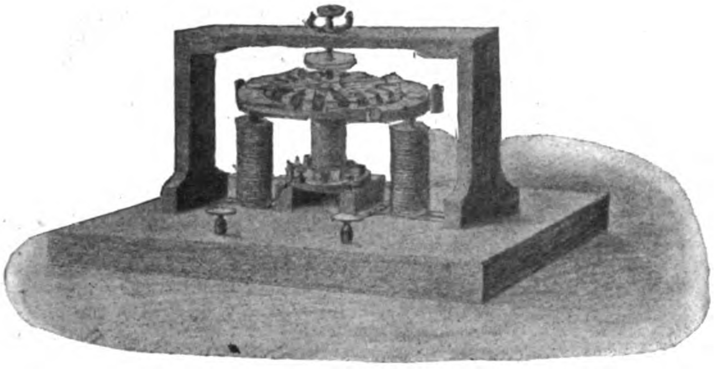


FIG. 5.—PACINOTTI MACHINE OF 1860.
(From an original drawing.)

The importance of Pacinotti's work appears to have been almost wholly unappreciated until after the labors of Gramme and of Hefner-Alteneck had demonstrated the industrial possibilities growing out of the conversion of mechanical into electric energy.

A TUBULAR ELECTRIC RAILWAY FOR PARIS.

AN underground tubular electric railway of the Greathead type, from the Bois de Boulogne to the Bois de Vincennes has been sanctioned by the municipal council of Paris. The tubular tramway will be constructed of metal. As the tunnel is driven ahead cast iron plates will be bolted together, forming a solid and durable wall.

ON THE CONDITIONS AND REQUIREMENTS OF A PRACTICAL CONDUIT TROLLEY SYSTEM.—I.

BY

R J Hewett

THE writer has studied the above subject with a view to designing a practical conduit trolley system applicable to the various conditions which may have to be met. In looking into these conditions and requirements, the writer has endeavored to be guided by practical affairs as far as possible. The following is submitted as being some of the more important requirements of the case. Many things are mentioned which might be considered as commonplace and well known, but they all aid us in arriving at useful results.

The first and most serious question is that of drainage. That the conduit should be provided with ample sewer inlets at all low places has been well recognized. But we must not expect too much of this alone. The street itself should have careful attention. The sewer inlets of the street should be ample to carry away excessive rainfall so as to avoid overflowing the entire street and conduit. All sewer inlets both in the conduits and on the street surface should be carefully inspected at proper times, and in case of heavy rainfall inspectors should be despatched to all low and dangerous places to look out for obstructions at sewer inlets. Thorough street cleaning will do much to obviate this difficulty. The matter, therefore, seems to open up the question of responsibility, and co-operation of the municipal government who should certainly do their share of the work. The street and sewer departments should cooperate with the street car companies in perfecting the surface drainage of the streets so as to avoid overflowing the conduits. In many cases additional sewer inlets may be required.

Where the grade of the conduit is sufficient, cleaning can be effected by flushing out with water from the street mains, permanent connections being established at the higher points for this purpose. The connections with the mains should be ample so as to admit a large quantity of water. A large quantity of water flowing a short time will do more cleaning than a small stream flowing continually. On levels where the flow of water is not sufficient to carry away the dirt, scrapers will necessarily have to be used as is now the practice with cable roads.

As to the size and shape of the conduit, it is obvious that the larger it is, the better. The shape and width should be such as to permit the supply wires to be placed as far from the slot as possible. The bottom of the conduit should be shaped so as to facilitate flushing out with water. Regular cable conduits are well planned for this purpose, but unfortunately they have never been able to realize much advantage from their good shape for the reason that the tar which drops from the rope forms a very adhesive and obstructive mass in the bottom of the conduit and cannot be flushed out with water. Fortunately, electric conduits do not have this difficulty to contend with.

As to the material and method of construction, we have an excellent precedent to follow in cable railway conduits. In these the body of the conduit is constructed of concrete in a continuous manner, the whole forming a monolithic structure from end to end of the road. This construction, although possibly more expensive than others, gives more strength and durability to the entire permanent way, there being little or no repairs to the line after it is once properly laid. Aside from this it is possible to take advantage of the fact that there is ample space available in the body of the concrete mass in which to construct feed wire conduits and thus avoid the expense of separate conduits for this purpose.

The insulation of the supply conductor is a matter almost equal in importance to the drainage of the conduit. Insulation supports in conduits loose their efficiency through two causes, namely, moisture, which exists in all kinds of weather both wet and dry, and dust which finds its way into the conduit in dry weather and adheres to the more or less moist surface of the insulator. The situation is much worse than is the case with ordinary out-door insulators. The latter have a decided advantage in getting washed off every time it rains. The conduit insulator is never washed off. From these considerations the writer concludes that it would be a good plan to place manholes at each insulator so that they can be cleaned. A special form of oil insulator which cleans itself automatically, invented by the writer, was described in The Electrical Engineer of March 30 and May 18, 1892.

The next question is, How to deliver the current to the car; whether by means of one conductor or two; by bars or simple trolley wires; by underrunning or overrunning contacts? In deciding these questions we should look at the future requirements and possibilities of the case. We should consider the possibility of extensive electric conduit systems with crossings and turnouts, as well as the crossing of cable lines, and plan everything so as to provide as simple devices as possible for all the conditions to be met.

The two-conductor plan has the advantage of entirely isolating all parts of the conductor system from the street and is therefore least dangerous, and as the wheels and rails form no part of the conducting system the presence of dirt or ice on the rails has no effect on the electrical part of the system as is the case with a single conductor. It also has the advantage of an insulation resistance twice as high as with one conductor, the same insulating device being used in both cases. The disadvantages of the double-conductor system are that the outlay for copper is doubled; the moving contacts, frogs and crossings, are double and therefore somewhat more complicated and liable to cause trouble.

The single-conductor system has all the advantages of simplicity and cheapness of the overhead trolley wire but has the disadvantage of only half the insulation resistance and also of having one side of the system, the track and slot rails, exposed to contact. By placing the supply conductor entirely out of reach of meddlesome boys, and providing proper protective appliances for workmen when handling the trolley device, the question of danger need not be serious; the main question is that of insulation. The single conductor plan has a great advantage in the copper outlay, due to the fact that the track return has a valuable auxiliary in the slot rails and yokes. By laying the slot rails so as to break joint with the track rails it will hardly be necessary to bond the rail joints. This has had practical proof in the case of cable roads which have been changed to the electric overhead trolley system.

As to the form of the conductor we note that in nearly all of the conduit work done so far bars have been used. This plan necessitates expansion joints and insulating supports at closer intervals, with consequently increased leakage due to the increased number of insulators. The simple trolley wire plan has the advantage of taking care of its expansion by means of the sags, and the insulators can be spaced further apart.

In determining the distance below the surface of the street at which the supply conductor is to be placed, we must consider the position of cables to be crossed, and place the supply conductor a sufficient distance above the cable to avoid fouling the running contact at the crossing.

As to the moving contacts, an underrunning contact will require wide gaps in the conductors at crossings and junctions to permit the passage of the bar which carries the underrunning device and seems to be objectionable on this account. The overruning device will have almost all the simplicity of the overhead trolley system, and can be removed from the conduit more easily than the underruning contact. The contact device should be so designed as to always keep in contact with the supply conductor and to pass turnouts, crossings and cable gaps of considerable width without displacement.

The trolley device should be adapted to run in either direction without readjustment and should be easily attached and detached from the car so as to provide for through traffic between conduit and overhead systems. It should be easily removable from the conduit so as to provide for the transfer of rolling stock from one track to another in case of fires or other causes and slot rail gates should be provided for this purpose at suitable points on the line. In a subsequent article will be given a description and plans of a practical conduit trolley system designed in accordance with the requirements just enumerated.

THE SPERRY ELECTRIC RAILWAY APPARATUS.

A great deal of interest has been aroused in the Sperry electric railway apparatus, the invention of the accomplished young electrical engineer, Mr. Elmer A. Sperry, and now being introduced by the Sperry Electric Company, of New York City. This apparatus has, it is stated, now been in use for nearly a year at Youngstown, Ohio, with very good results. We illustrate it herewith in Figs. 1 and 2.

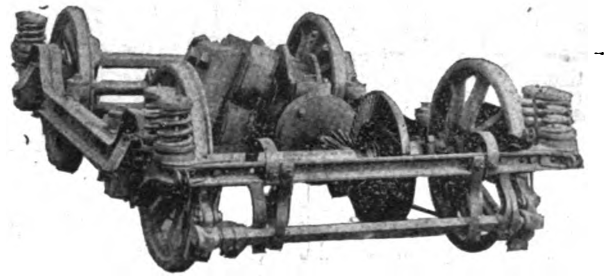


Fig. 1.—The Sperry Electric Motor—Showing Bevel Gear.

The equipment consists of a single motor, flexibly mounted on the truck, the armature running lengthwise of the truck, having a hollow shaft through which runs the pinion shaft driving both axles through bevel gears. Between this pinion shaft and armature shaft is a flexible gear. The motor is a 40 h. p. single reduction, with a slow speed armature. The gears are a special design, with broad face and very strong. The housings for these gears, forming the bearings for the pinion shaft, are likewise very strong and of particular design, and have proved in practice to be admirably adapted for the purpose. The gears on the original equipment running to-day at Youngstown are in splendid condition and have not been running in oil, though all equipments now manufactured have gear covers, allowing the use of oil on the gears. By this method of flexible support and flexible connections it is claimed the Sperry Company obtain the maximum tractive effect with a minimum expenditure of power, having a single 40 h. p. motor with one armature, instead of two 15 h. p. motors having two armatures, giving the total weight on the wheels for traction and having the minimum weight on the wheels, without springs. The Sperry Company also control the use of devices intended to protect life and property in the event of a breakage of the trolley wire.

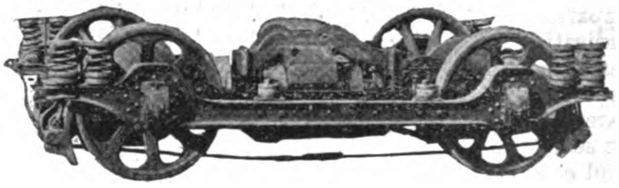


Fig. 2.—The Sperry Electric Street Railway Motor—Side View.

A BIOGRAPHICAL SKETCH OF THE KHOTINSKY ACCUMULATOR.—II.

BY

Capt. A. de Khotinsky

In the spring of 1881 much talk was heard of the discovery of M. Camille A. Faure with reference to accumulators. This rumor caused the laboratory of *l'Electricien*, under the direction of Messrs. Planté and Hospitalier, to have a large battery of Planté accumulators made to prove that the Planté accumulators had more capacity per kilogram of lead than the accumulators of Faure. I took no active part in these proceedings, but preferred, on account of practical experience, which I had already gained with Planté accumulators in Russia, not to let myself be carried away by other people's influence. I had set myself the task of constructing an accumulator, by which the defects could be avoided that were peculiar to the experiments I had made with the Planté system.

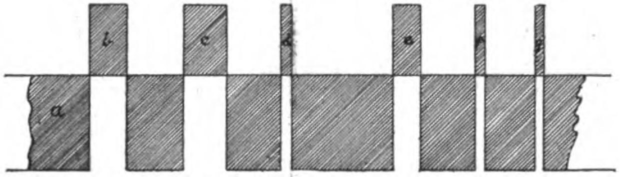


FIG. 10.

Next I considered how it would be possible to prevent short-circuiting inside, caused by the falling off of oxide from the surface of the positive electrodes. When the loosened oxide fell down in powder and scales I was satisfied with the construction adopted in 1874, of parallel plates, to avoid short-circuiting. Since therefore, as experience showed, the oxide in layers loosened from all over the positive plates, the distance of the positive from the negative plates in the accumulator should have been as great as the height of the positive plate itself, but this arrangement was not practicable. A remedy for that was to make separating walls to prevent the falling oxide scales touching the negative plates, or else to make the positive plates so that only scales of small size could fall off; and this size of the scales must be such, that the falling could take place without touching the negative plates; or else the oxide must be made to fall off only in the form of powder.

A great disadvantage, peculiar to the Planté accumulator, was noticed in its short life as a producer, and this short life as a producer was by no means in proportion to the amount of work necessary to form it; and after this comes total exhaustion together with useless existence. In this it resembles a paralytic, who, indeed, takes nourishment but is unable to exert energy.

The above diagram shows clearly the run of life of accumulators made of common lead plates. This diagram is to be compared with the life of a strong spirit in a weak and sickly body. The spirit spontaneously flourishes and may do great things, but its physical power is soon exhausted.

After having taken rest, recreation and care, we see a new start, but—the first spurt can now no longer be repeated—weakness of body and exhaustion makes itself still more perceptible. Later attempts and renewed efforts for a last trial for work only prove useless and unprofitable and the spirit and body sink in lassitude and lethargy.

The part below the line which intersects the diagram, Fig. 10, shows the work required for the bringing up of the accumulator, and the care expended for its recovery; that below the line shows what the Planté accumulators are able to return in work. The first part *a*, under the line, which is about twenty times as large as *b*, is the bringing up, the forming, of the accumulator. *b*, above the line, marks the first activity of life; after the finishing of the forming process. *c*, above the line, marks the first spontaneous display of the will power, the highest point of capacity.

d, hasty exhaustion of the weak bodily powers; the first falling off of oxide. *e*, beginning of fresh activity after having had care and recreation, after long-repeated charging. *f*, bodily weakness is more perceptible; the falling off of whole scales of oxide.

g, after renewed care—entire cleaning of the cells, new arrangements—later attempts to work, but all is useless and unprofitable and the spirit and body sink in exhaustion and indolent lethargy—the accumulator takes the charge, but returns no energy.

From all that has been said it follows that in the nature of this accumulator, this principle underlies: That when it reaches the highest point of formation, then also begins its degradation. From this it will be seen that the very formation which gives power is the cause of its ultimate failure.

Hence came the necessity of adopting a construction, which either made the forming totally unnecessary, or at least that only a short period of formation should be necessary for the highest attainable capacity per kilogram of weight. For this purpose I worked to get out of the same weight of lead the largest possible surface in order to have the same weight of oxide, but distributed in proportionately thinner layers; because for the production of thicker layers the time required varies as the square, and for still deeper oxidation, as the cube.

The larger spreading of surface of the same weight of lead has the further advantage that the oxide carrier becomes much thinner. Thereby the falling off of oxide from the support is avoided, because the thinner the oxide carrier is, the easier it can expand with the oxide. With a thicker carrier its expansion is difficult or impossible; the expanding oxide must according to the laws of nature, therefore necessarily loosen and fall off from its immovable supporter.

All this led me to produce a type of accumulator, of which I gave Mr. N. de Kabath a description, and I authorized him to take out a patent for it in his name as an acknowledgment for his permission to let me work in the laboratory of *l'Electricien*, and as an indemnification for financial aid which he had given me for this work. This accumulator, shown in Fig. 11, is known under the name of "accumulateur gaufré N. de Kabath."

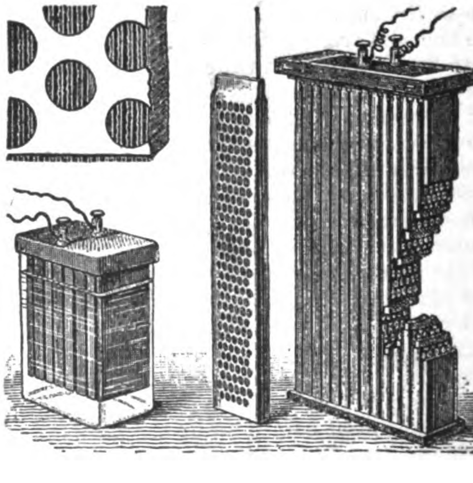


FIG. 11.

In constructing this accumulator lead strips were used, 0.1 mm. in thickness, one-half being directly cut in the required length of 36 cm., the other half originally 56 cm. in length being reduced by corrugated rollers. These flat and corrugated strips to the number of 180 or 190 were laid alternately one upon another, and the whole fitted in a thin covering which was perforated on the side, and was bound closely around the strips. This covering resembled a very long envelope perforated on both sides, 38 cm. in length, 9 cm. broad, 1 cm. thick and 1 kilogram in weight. At the narrow end was fixed a lead strip, and the covering was perforated with rows of small holes, so that in the complete battery the liquid could circulate freely.

In the year 1881, the Paris Electrical Exhibition was held. During my stay in America, the American Maxim Company with which I was connected invited me to assist in establishing their great exhibition in the Palais d'Industrie, where the exhibition was held. For lack of time for further investigation and development of the above described "gaufré accumulator," I gave the charge thereof to one of my employees, Mr. Bernardos. In September, 1881, several batteries of these accumulators were finished and sent for the purpose of practical experiments to America, England and Spain.

My duties in the exhibition were various. Subsequently the contract for lighting a part of the great opera house by means of Maxim glow lamps was given to me. From this resulted the sale of the patent on Maxim incandescent lamps for France to the Jablochkoff Company, on condition to deliver 100,000 incandescent lamps within six months. I established then a manufactory for the purpose at No. 17 Rue des Martyres, and was consequently so much occupied that it was impossible to personally supervise the further development of the gaufré accumulator.

THE COMPARATIVE EFFICIENCY OF THE COMMUTATED FIELD AND THE EXTERNAL RESISTANCE CONTROLLING RAILWAY SWITCHES.

BY

Thorburn Reid.

So far, the prevalent practice in the speed control of street car motors employs a change in but two elements, viz., resistance of the main circuit and field turns. Of the two methods mentioned in the title, the one varies the resistance only, the other varies both the resistance and the field turns.

For purposes of comparison, we will assume that the resistance, turns in field, speed, current, etc., are the same in the two methods when all the external resistance is out of the circuit in the one and all the field turns are in parallel in the other. This assumption is both necessary and proper. Proper because there is nothing inherent in either method to necessitate a difference in these conditions and whatever change in them increases the efficiency of either will be of advantage also to the other. It is necessary also because a comparison of the efficiency of two methods of regulation is sought and to make this comparison it is necessary that all extraneous conditions should be the same in both.

The loss by hysteresis and eddy currents may be neglected, since although it may be appreciable in some cases, the difference in its value due to the two methods is negligible.

We will inquire then what effect increasing the number of turns in addition to increasing the external resistance (for the purpose of reducing the speed) will have on the loss of energy in the motor and in the controlling device. Before proceeding with this comparison, note that the number of turns in the field equals the ampere turns divided by the current through the armature. In other words, two or more turns in parallel count only as one, for as far as their effect is concerned the turns in parallel with each other could be replaced by one turn carrying the sum of the currents which were in parallel.

For simplicity we will use numbers rather than letters of the alphabet for the quantities involved, showing as we go along the general application of the principles brought out.

Starting then under the conditions mentioned above, assume the resistance in circuit to be 10 ohms, the current to be 10 amperes, the line E. M. F., as usual, 500 volts, and the speed 10 miles an hour. Suppose now the resistance is doubled. The current would immediately be reduced thus reducing the torque. The speed would then commence to decrease, thus reducing the counter E. M. F. and increasing the current again. As the speed decreases the torque required to drive the car becomes less and less and the torque furnished by the motor increases with the current. This process will continue until the torque furnished by the motor equals that required to drive the car at the speed to which it has been reduced. The speed will then remain constant at this lower value. It thus becomes evident that the value of the current that will flow under these new conditions depends only on the variation of the torque required to drive the car with the speed, and on the variation of the torque furnished by the motor with the current. Let us first examine the variation of the torque with the current. By the well-known formula the work furnished by the motor equals the current multiplied by the counter E. M. F. The counter E. M. F. (the number of armature turns being constant) is proportional to the field strength and speed. The work is therefore proportional to the field strength, the current and the speed. Torque being proportional to work divided by speed is proportional to the field strength and the current. To arrive at this in another less mathematical way, the torque may be considered as due to the force exerted upon each other by the poles of two magnets, the one the field magnet, the other that armature considered as a magnet, whose poles are always nearly in the same position relatively to the field magnet poles; the distance between these poles remaining very nearly constant, the attraction or repulsion between them will vary very nearly as the products of their strengths, or with the field strength multiplied by the armature strength, the latter being proportional to the current flowing through the armature coils. The field magnets of street car motors are in present practice very highly saturated and a change in the ampere turns does not change the field strength in anything like the same proportion. Consequently the torque, instead of varying as the square of the current, as would be the case if the field strength varied directly as the ampere turns, varies more nearly as the first power of the current. Thus reduction in torque requires a larger reduction in the current when the field magnets are highly saturated than when the saturation is low.

The variation in the torque required to drive the car at different speeds is not very great between the limits used on street railways and the torque is generally assumed to be constant, an assumption which is not inadmissible when we consider the diverse conditions of track, load, lubrication, etc. Such an assumption will make our reasoning much simpler without vitiating the conclusion finally arrived at, since our purpose is to compare two methods of regulation and whatever the torque may be at different speeds, it will be the same for both methods of control at the same speeds.

To return then, what will be the effect of doubling the resistance in circuit? Since by assumption, the torque required remains constant, the current will have finally the same value as before and will require twice the E. M. F. to drive it through twice the resistance, or 200 volts. The counter E. M. F. is reduced to 300 volts and the speed, which is proportional to the counter E. M. F. if the current (and therefore the field strength) is constant, is reduced in the proportion of 400 to 300, or to seven and a half miles an hour.

Next, without changing this resistance, double the number of turns on the field. The current will immediately be reduced on account of the increased counter E. M. F. due to increased field strength. Suppose the field strength were thus increased 20 per cent. The counter E. M. F. would thus be increased to 360 volts and the current reduced to seven amperes. The torque would then become .7 × 1.2 = .84 of its former value and the speed would commence to decrease. This would decrease the counter E. M. F. and increase the current, thus increasing the torque until it reached the value required by the car at the lower speed. Now to get back to the speed we had before the turns were increased it is necessary to decrease the resistance in circuit. Thus for the same speed both the current and the resistance are reduced, and therefore the *C R* loss[1] is reduced, by increasing the number of turns on the field.

Again, if enough resistance were inserted to reduce the counter E. M. F. to less than half the applied E. M. F., an increase in the field turns would increase the torque (see foot note) and speed and resistance would have to be added to bring the speed down to its former value, but that the loss of energy would still be less can be shown as follows: The work given out by the motor at any speed is the same for either method and equals the current times the counter E. M. F. The current is reduced by increasing the field turns. Therefore the counter E. M. F. must increase if the work is to remain constant and *CR* must decrease. Therefore the loss, which equals *CR* times the current, must be less since both *CR* and the current are less.

The reduction in the current is also of further advantage in that the loss in the line and in the dynamo at the power station is also reduced, thus increasing the total efficiency of the plant.

This reasoning has shown that the commutated field is more efficient than the external resistance method after the speed has become constant; but in street railway practice a large part of the energy of the motor is expended in accelerating the speed of the car, and it remains to show the relative efficiency of the two methods under these conditions.

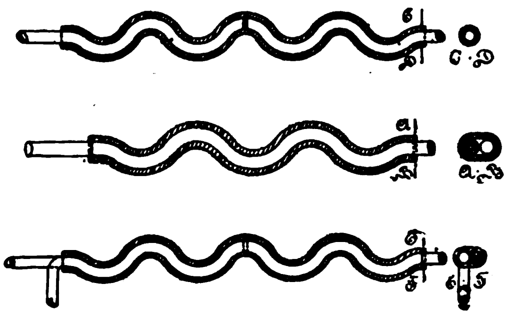
We may consider the resistance to acceleration or the inertia of the car as an additional load put on the motor, but one which is continually changing as the speed of the car changes. A glance at the above reasoning will show that the load was one of the conditions which was assumed to be the same in the two methods. Further, it was proved that at each speed and torque the loss of energy was less with the commutated field method than with the external resistance method, and with equal torque and speed the resistance to acceleration, or the "inertia load," would be the same in both, and thus the above reasoning applies to this condition also.

Finally, it must be remembered that we have considered the comparative efficiency of these two methods, and that only from an electrical point of view. As to their mechanical efficiency, their adaptability to the end in view, their cost and ease of repair, nothing has been said in this article, because these are matters only to be determined by experience, and a discussion of them would be beyond the scope of this paper. I have only tried to answer a question about which there seems to be much confusion. Even practical men of long experience express a doubt as to which takes the most current, a car controlled by the commutated field method or by the external resistance method. To this question the above reasoning gives the answer that a car controlled by the commutated field method requires the least current.

The fact is also brought out that for the same speed and torque the resistance is also less when the counter E. M. F. is greater than one-half the applied E. M. F. The amount of this difference in the efficiency depends on the saturation of the field magnets and on the length of the field gap. In other words, it depends on the saturation curve of the motor. The higher the saturation the less is the difference. The exact amount of the difference could only be ascertained by means of a saturation curve of the motor, and since that would require a complete and somewhat lengthy analysis and would then be a rather distant approximation to the actual difference of efficiency that would be obtained under the rough conditions of street railway practice, I have not considered it worth while to undertake it, at least in this article. That the difference would be considerable can be seen from the argument. That is the most important point and an answer to the main question at issue.

CONZ'S WIRE JOINT.

In this joint, described in the *Elektrotechnische Zeitschrift*, short tinned metallic tubes or sheets are slipped or wound on the wires. The point of juncture is then given a wave-like form. The engraving, Fig. 1, shows two wires joined in this manner with their ends abutting. Fig. 2 shows a joint in which the wires are placed side by side. Fig. 3 is a combination of both, showing the method of taking off a branch wire.



FIGS. 1, 2 AND 3.—CONZ'S WIRE JOINT.

Our contemporary states that it has examined these joints, which throughout exhibit such close contact between wire and enclosing shell that soldering seems unnecessary. Should the latter be desirable, however, it can be easily affected, as the tubes are tinned. The new joint is the invention of Mr. Gustav Conz, of Hamburg, Germany.

BRAIN'S PROPOSED UNDERGROUND CONDUIT FOR ELECTRIC CAR LINES.

Mr. C. T. Brain, of Liverpool, has recently proposed an ingenious form of closed underground conduit for electric car lines. His idea is to build the conduit with a comparatively wide slot, and then to cover this opening with a stout iron rail, lying flush with the surface of the street. To enable the collector attached to the car to come in contact with the cable, this rail is raised from its seat as the car goes, by rollers beneath it, which are carried on U's attached to the car. After the car has passed the cover rail falls back into its place. Thus at any time the conduit is open only under the car, being completely closed both before it and behind it by the cover rail. The wide slot which can be used with this system enables the collector carriers to be made of ample strength, and by removing the cover rail of any section the cable and its supports can be easily got at for repairs, no taking up of the roadway being required. The cover keeps the conduit free from dirt, which would injure the insulation of the conductor.

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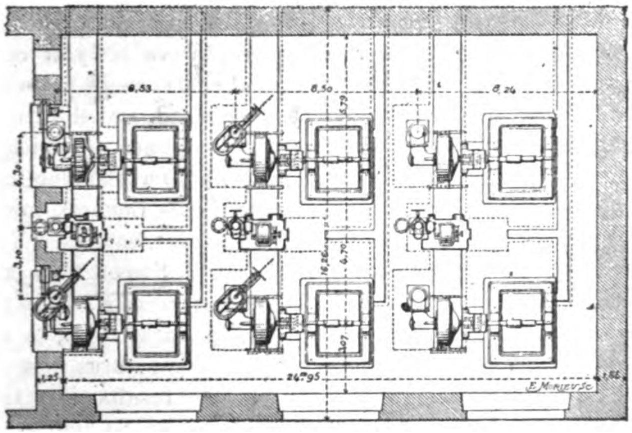
[1] This reasoning only applies as long as the counter e is less than ½ the applied E, which is usually the case in street car motors, except when they are starting from rest. This can be shown as follows: If T = torque, N = field strength, S = armature turns, n = revolutions per second and e = counter—E. M. F. we have $T = NC = N\frac{E-e}{R} = N\frac{E-SNn}{R}$ $\frac{dT}{dN} = \frac{E}{R} - \frac{2SNn}{R} = \frac{E-2e}{R}$. This expression is negative when e is greater than ½ E and positive when e is less than ½ E. That means that any increase in the field strength will decrease the torque when e is greater than ½ E and increase it when e is less than ½ E. That the field strength must necessarily increase with increase in the field turns can be negatively proved as follows: If the field strength either remained constant or decreased, counter e must either remain constant or decrease, and the current therefore must either remain constant or increase, and in either case the field strength would be increased, which is contrary to the hypothesis. Therefore the field strength must increase when the number of field turns is increased.

HIGH-TENSION POWER TRANSMISSION BETWEEN TIVOLI AND ROME.[1]

As our readers are aware, the city of Rome has for several years past had an alternating current station in operation, installed by Messrs. Ganz & Co., of Budapest, and operating at 2,000 volts, with steam power. This station has been increased from time to time, but, the demands continually growing, it was finally decided to utilize the Falls of Tivoli, at a distance of about eighteen miles from Rome. This distance naturally made it necessary to increase the potential in order to avoid serious losses, and for that purpose the E. M. F. employed at Tivoli was raised to 5,000 volts. This potential is carried to the outskirts of Rome, where it is lowered by means of step-down transformers to 2,000 volts. This potential is carried into the city and distributed to the local transformers, which finally reduce it to 100 volts in the distribution circuits.

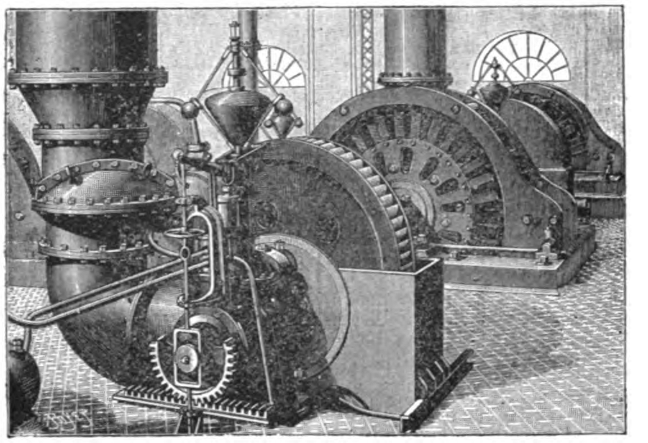
The generating station at Tivoli is placed beside a waterfall of 110 metres, of which 10 metres are utilized for local industrial installations. This fall has an available capacity of 3,500 litres per second. The station is a solid structure on the side of a very picturesque hill, the main machine-room being 25 metres long and 15 metres broad. Nine turbines are employed, as shown on the plan, Fig. 1. The nine turbines form three groups, each of which is composed of two turbines of 330 h. p., and of a small one of 50 h. p. All these turbines are of the Girard type with horizontal shaft and part gate, the automatic regulators being of the Ganz type, the arrangement being shown in Fig. 2. The two turbines of each group are directly connected to and drive an alternator furnishing 42 amperes at 5,100 volts at a speed of 170 revolutions per minute. The armature is 2.2 metres in diameter and has 30 pole-pieces, giving a frequency of 42.5 periods per second. The small turbine of each group operates a four-pole exciter and at a speed of 375 revolutions per minute delivers 150 amperes at 180 volts, this current being sufficient for the excitation of three alternators.

All the alternators are coupled in parallel and also the exciters, which considerably simplifies the regulation ; and rheostats have been introduced into the exciting circuit of each alternator. But the regulation proper is effected by means of two Blathy automatic rheostats acting on the field current of the exciters and regulating their current in such a manner that the potential of the alternating current is maintained constant at Rome, the losses in the line being compensated for by a potential equalizer. The main switches consist of ebonite cylinders containing mercury, in which contact rods dip.



Plan of Main Dynamo Room at Tivoli.

The line from Tivoli to Rome traverses the deserted Roman Campagna, and consists of four copper cables of 12 strands, each of 2.6 mm. in diameter, corresponding to a section of 100 sq. mm. and having a total weight of 100 tons. At full load the loss on the line is about 20 per cent. The cables are supported on heavy oil insulators at points 35 to 40 metres apart. The poles to which the insulators are attached consist of two T-beams, 21 centimetres wide, placed side by side and riveted together. The pole-line also carries two silicon bronze wires, 2 mm. in diameter, designed for telegraph and telephone purposes.



Alternators Driven Direct by Turbines at Tivoli, Italy.

The high potential line is carried to the sub-station at the Porta Pia, Rome, arriving there at a potential of 4,000 volts. Here it is reduced to 2,000 volts by means of 32 transformers of 25 kilowatts each. One group of 16 transformers transmits 2,000 volts alternating, to a concentric system of cables serving for the general distribution of current in Rome. The second group of 16 transformers is employed to furnish current for arc lamps. Each transformer feeds 45 lamps at 14 amperes. There are 14 transformers in service, which correspond to 600 lamps ; the other two remaining transformers act as a reserve. An automatic rheostat receives the circuit of each series of lamps and maintains the current constant at 14 amperes by introducing or cutting out resistances; but in order to reduce the losses as much as possible the secondaries of the transformers can be coupled so as to produce 500, 1,000, 1,500 or 2,000 volts. In this way the potential can be changed very easily during the run. The total energy transmitted amounts to about 1,200 h. p.

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[1] *La Nature.*

HOW TO SPEAK WITH MARS BY THE MORSE SYSTEM.

I INFER, from the astronomers, writes the Rev. Mr. Haweis, in the English newspapers, that a signal on our earth about six miles in size, of the nature of a bright light, could be seen by the inhabitants of Mars, who by all accounts seem to be making the most systematic and herculean efforts to communicate with us by flashing triangular signals of presumably electric light. Why cannot we answer those signals by something which would resemble the lighthouse intermittent signal? Here is the method. London every night presents an area of at least 12 miles square brilliantly illuminated. That illuminating power might be enormously increased with only a few additional centres of powerful electric light. But without *any additional expense*—a little co-operation on the part of the gas companies—it would suffice to alternate darkness and light at intervals of five minutes over the whole of London between certain hours when traffic is more or less suspended. If only tried for an hour each night some results might be obtained. The citizens would have lights in their houses, the vehicles would still have their unimportant and shielded lamps, and as every five minutes the lights would be simultaneously turned up, no very extensive burglaries or outrages could be committed. Into the details and mechanism of such a scheme I need not enter. If the lights in the Albert Hall can be simultaneously extinguished or lowered, so could the lights in a street or a thousand streets.

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VOL. XIV. NEW YORK, SEPTEMBER 21, 1892. No. 229.

Great as are the triumphs of the present century, we may well believe they are but a forecast of what discovery and invention have in store for mankind.—Lord Rayleigh.

THE DAY OF THE ELECTRIC LAUNCH.

AS a matter of fact, the electric launch is an unknown thing in this country. One or two boats have been built and put into commission, but at the present time there is hardly half-a-dozen of them. In Europe, however, these launches have become widely known. On the upper Thames, for example, it is impossible to spend an hour or two on the water without seeing several of them; and the number used by Londoners is rapidly on the increase. They are certainly preferable to the fussy little steam launches with their ugly "wash," and have not proved costly to build or maintain. Perhaps one reason for the rarity of electric boats in America has been the extreme popularity of naphtha launches, whose name is legion; and another reason has undoubtedly been the greater length and width of our inland waters, rendering navigation by small craft more or less risky. A third reason may have been the comparative rarity of charging stations, but in view of the great use made of the incandescent light at our pleasure resorts along the water, this trouble lessens every season. It will be a long time before the Hudson, for instance, has the density and continuity of population that the Thames and Seine have; but even now its shores from New York to Albany are fairly well dotted with places where it should be possible to obtain a supply of current.

Moreover we believe that with the unquestionable growth in popularity of aquatic sports and pastimes in America, there is to be found encouragement for the formation of local launch companies, such as that which is to carry passengers at the World's Fair. Just two years ago, Mr. Fred. Reckenzaun, an authority on this subject, published in these pages a careful and exhaustive article on the subject, and gave it as his opinion that a complete charging plant, with 12 launches each capable of running 60 miles at six miles an hour, could be equipped, all expenses for land, etc., in-included, for $32,050. These boats could be run for five months in the year for $905 apiece, making a total run each of 9,000 miles in that time. If these boats carried about 10 passengers each trip, the investment would be profitable, at the low rate of a cent per mile. The figures seem to us quite reasonable, as they do not take into account any special hiring of the launches,—a very profitable class of business; and we would greatly like to see the experiment made.

This subject of storage launches is brought up again by the successful trip of the "Vashti" of which an account is given on another page. It is late to begin storage battery launch work for this year; but it is none too early to begin mapping out a programme for next year, when Mr. Astor, with his new storage launch, bids fair to set the fashion in this field. He will be very extensively imitated.

TESTS THAT MEAN NOTHING.

RADICAL improvements and innovations in the older engineering branches are now of such comparatively rare occurrence that the societies devoted to these branches are largely given to the discussion of modifications of older and well-established work, and the civil engineering societies especially have their meetings taken up by the reading of papers on current work, which, though frequently exhibiting great constructive ingenuity, does not possess that novelty of character which similar productions, presented to societies devoted to the more recent developments of engineering, may lay claim to. It is not strange, therefore, to note the occasional reading of a paper on work accomplished some years ago, but which through lack of opportunity had not been brought out at the time of its completion. This tardy recording of the results obtained in a permanent structure, for instance, would, as a rule, be of no serious consequence. But when a paper treating of a new art and read before a representative body of men, fails to point out the progress in the art made since the time of its writing, it is very apt to mislead, and thus to do an injustice to many workers in the branch of which it treats. We are led to these reflections in glancing over the advance copy of a paper by Mr. Louis Bonnett, junior member of the Society of Civil Engineers, entitled "Test of Power Required to Drive Electric Street Cars and Total Efficiency of Motor." These tests were made on the Seashore Electric Railway at Asbury Park, N. J., in the summer of 1889, on a road equipped by apparatus now obsolete, and operating at 220 volts! The results show that the efficiency of the motor varied between 24 and 56 per cent. Granting even that the tests were properly carried out, their publication at this time, and their presentation before the American Society of Civil Engineers, without reservation, is an injustice. The author has not taken the slightest pains to explain that since that time electric railway apparatus has been vastly improved; nor that the motor efficiencies obtained at present are considerably higher; nor that even at the time at which the tests were made there were roads in operation in which the efficiencies were higher than those found by the author of the paper; nor that a higher and much more economical voltage is now universally used. We feel it our duty to thus point out these facts in order to guard many civil engineers from obtaining a wrong estimate of the efficiency of electric railways, an error into which they would be very apt to fall upon the perusal of the paper referred to. As to the ability or standing of Mr. Bonnett, we have no word of criticism. We believe him to be an able and competent engineer. But all the same, these tests are not fair to the electric railway either of to-day or in 1889, and we cannot let them pass without protest.

COPPER VERSUS NICKEL AS A CONDUCTOR.

It is acknowledged to be a difficult task to impart to a large number of new workers in the field of electricity that knowledge which is essential to the proper carrying out of details of electrical construction; and, indeed, it is too much to hope that the general public can share a knowledge of the management of even the most simple electric installations. The hopelessness of this task is again forcibly brought to our attention by the apparent absolute inability of many to distinguish between the relative conductivity of metals. A striking example of this is shown in a recent instance which has come under our notice in which a search for trouble on an electric circuit developed the fact that the regular fuse wire had been replaced by two five-cent nickels, each clamped in the fuse screws and contact being formed by the mere butting of the nickels. When we consider that the specific resistance of nickel as compared to that of copper is as 8 to 1 it is incomprehensible why the genius that inserted the nickels did not employ copper pennies. On the score of expense alone, it should have occurred to the merest tyro to have used them in preference. It is strange, indeed, that since the question of expense seems not to have been taken into consideration, trade dollars were not used for the purpose. The conductivity of silver exceeds even that of copper, and the color of the metal resembles very closely that of the fuse wire. It is apparent that the public needs more knowledge as to the conductivity of trade dollars, nickels and penny pieces.

THE DEADLY FAN MOTOR.

We would suggest to our esteemed contemporaries of the daily press in this city that just by way of variation on their weary cry against the "deadly trolley," they begin a crusade against the deadly fan motor. It has long been known that when thoughtful people stick their fingers near a revolving electric fan, the careless motor goes on, and flippantly slices part of their fingers off. But now comes a Washington paper which reports that a young man who never before knew what sickness was, has died suddenly after "contracting pneumonia from sleeping within reach of the breeze from an electric fan." Now, as the deadly trolley itself has never killed anybody, and as here is a direct case of murder on the part of the fan motor, how much more "deadly" must the fan motor be! There is an old legal decision reported by Cowper, in one of his poems, as to the dispute betwixt eyes and nose, in which it was ruled that when the nose put spectacles on, eyes must be shut. Very much in the same way, it would be fitting for the daily papers to decide that when people fall asleep near fan motors, the motors must stop. That is the only way to prevent these outrageous murders, unless we stop the fan motors altogether. Perhaps that would be the best thing for the public welfare and safety.

ELECTRIC TRACTION OTHER THAN BY TROLLEY.

In the last issue of The Electrical Engineer we ventured, even while defending the trolley from the reckless and foolish aspersions cast upon it, to express the belief that the time would eventually arrive, or might even be at hand, when both the storage battery car and the conduit car would make a place for themselves. The remarkable letter signed "Gautherot" went to prove our assertions and support our hopes, in regard to the storage car. This week we have an excellent article from Mr. R. J. Hewett, of St. Louis, discussing the lines upon which a practical conduit system must be laid down, and in the observance of which success would be found. None of the conditions that Mr. Hewett names embodies a serious or insurmountable difficulty; and that being the case, such a system as will embrace the necessary requirements must sooner or later be hit upon. Meanwhile the demand for operative methods of either kind, that shall obviate the need of resorting to the overhead trolley, grows daily louder and more urgent.

The Utilization of Station Exhaust Steam.

No little discussion has lately gone on as to the profitableness or advantage of utilizing the exhaust steam of central stations for a steam heating service; and although we have produced the evidence showing that it is worth while for stations to go into this line of work, some critics have advanced a number of able arguments against the scheme. Be their contention what it may, we are glad to note the fact that the Springfield, Ill., Electric Light and Power Co. is so well pleased with its exhaust steam enterprise that it has now contracted for an extension of its system, and will put in half a mile more of six-inch mains. A full description of the plant in question, by Mr. W. F. Collins, appeared in our issue of June 1, and we see in this new contract no ground for the withdrawal of any of the points then urged as to the economy, efficiency and profitableness of the plan adopted.

Antonio Pacinotti.

While Italy is not prolific in great electricians, she still can boast of Volta, Galvani, Pacinotti and Ferraris as her sons. These are illustrious names, and yet of one member of the quartette it has remained for The Electrical Engineer, twenty-eight years after his discovery and invention of the continuous current dynamo, to tell, for the first time, the interesting story of his life and work. To most electrical engineers Pacinotti has been but a great name, and it will amaze them to learn that he still lives. The story of his career and of his connection with the genesis of the modern dynamo, has been prepared for this journal by Mr. F. L. Pope, and the opening instalment appears in this issue.

CONNECTING SEVERAL TELEPHONE STATIONS BY A SINGLE LINE WITH AN EXCHANGE OFFICE.

BY ED. ZETSCHE.

MR. ELSASSER in 1883, and myself at various times, have published diagrams, showing the use of call signals invented by Kettell as well as Wittwer and Wetzer (*Dingler's Polyt. Journal* 1892, p. 283, Vol. 38) which enables the connection of several substations with the central office over a single line. Again, in 1885, Messrs. Grassi & Beux (*La Lum. Elec.*, Vol. XV, p. 530) have published another plan by which three substations may be called over one line. Lately the same subject has been taken up by J. J. Carty in his well-known bridging bell arrangement (New York EL. ENG. Vol. X, p. 330; also Vol. XI, p. 420). Another solution of the problem has been found by a gentleman residing in Luettich who has sent me his arrangement, which I shall presently describe in detail.

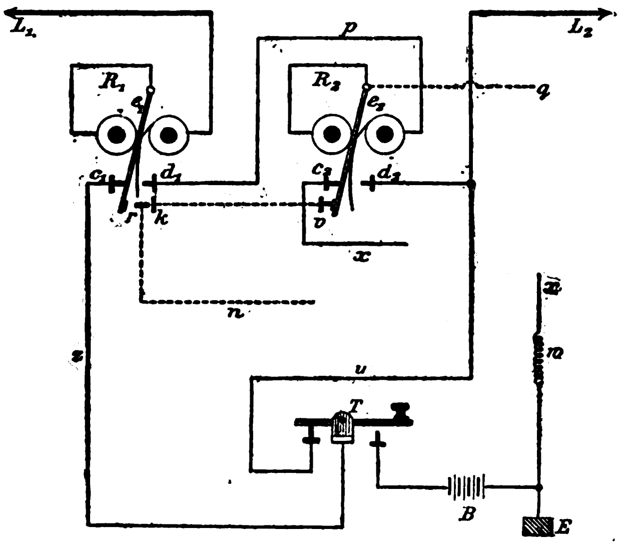


FIG. 1.

Assuming that telephone engineers are well acquainted with my prior devices (diagrams of which are shown in Figs. 1 and 2,) I desire to state briefly that in the arrangement I proposed *none* but the *subscriber called* received the call and the central station was obliged to use as many different strengths or graduations of current as there were substations on the line. This I achieved by means of two polarized relays at the substations, each responding to a different strength of current, so that whenever the central office sends a certain calling current of predetermined strength over the line, only that relay which, by means of its construction is adapted to respond, would operate. In operation this relay by its first motion cuts off the call current, establishing a new path for the conversation current through the telephone. At the same time the stations beyond the one called are automatically disconnected. The line resistance, which is thereby considerably decreased, is brought back to its original value by the introduction of a resistance coil. Means are also provided for the ringing of the alarm at the station called until the subscriber removes the telephone from the supporting hook.

In Fig. 2, the alarms W, are included in the line L_1 L_2, but only one polarized relay R is required. In this arrangement, the call is simultaneously heard by all substations, and an individual signal must be used for each subscriber. The central office employs for calling purposes currents of equal strength of such a direction, or polarity, that the armature *e* of the relay R is held against *c*. The station called presses the key T, sending a current of the same direction; moves the telephone F from the automatic switch U, thus changing the lever U from its resting contact *i* to *q*, and cutting off from L_1 the coil of the relay R as well as those of all stations beyond it, while at the same time grounding the line by means of F. The central station now sends a current of the opposite direction which in all stations up to the one called moves the armature *e* from point *c* to *d*, cutting off T and F. When the conversation is finished, the amatures swing back to *c*.

After this brief description of my prior arrangements, I will now describe the plan of Mr. M. J. of Luettich, reference being had to Figs. 3 and 4. The characteristic feature of his arrangement consists in placing the several substations in multiple, instead of in series, as has heretofore been customary. There are two ways of calling the subscriber. All relays may be wound to equal resistance and a different resistance placed in the circuit of each relay; thus the calling current is split up into several branch currents of different strength; but, as each of these branch currents affects its relay differently, only the instrument desired will respond.

All relays may be wound to a different resistance R, but the auxiliary resistances W_1, W^1, etc., are so constructed that the sum of R and W_1 is the same for all substations. In this case the calling current splits up into branches of equal strength, which currents become operative in relay coils wound to a different current strength. Consequently only a given number of substation relays will respond.

The arrangement for telephone installations, using a single conductor, is shown in Fig. 3, more especially the first substation I beyond the central office. It is to be noted that a somewhat sluggish galvanometer is included in the circuit of line L_1, L_2. Again the convolutions of the galvanometer G are connected with the spindle of the needle, which plays between two contacts V according to the direction of current passing through the galvanometer coil. A second line *l* leads from these contacts and passes seriatim all other substations included in L_1, L_2. Finally at I there is a derived circuit *q*, which, passing through a resistance *w'* connects the line to ground. This resistance, however, must possess a sufficiently high self-induction to prevent an injurious leakage of telephone currents.

At each substation at *j* a conductor is led from line *l*, which passes through a resistance w_1, the relay coils R_1, and thence to ground. The amount of auxiliary resistance W, as well as the number of convolutions of the relay is to be determined for each substation. From L_1, L_2, at *x*, a conductor is taken to the spindle of the relay armature *e*, thence to the contact screw *c*, (the resting point for the armature when positive currents pass through the relay and its customary position), thence through the telephonic apparatus S_1,

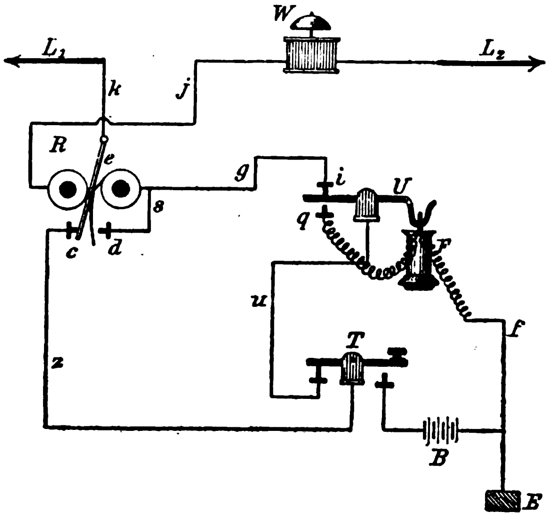


FIG. 2.

through a resistance W_1 over s to ground. The resistance W_1 must receive a well-determined value so that only infinitesimal portions of current may pass over x, e, c, W_1, s to ground. This resistance is only included in the circuit when no conversation is going on, which is accomplished by so connecting the resistance with the automatic switch that the act of removing the telephone short-circuits the resistance.

It will be seen that at all stations the relays are in derivation with line l, while the telephone apparatus S, of the substations usually are included serially in the line L_1 L_2 which terminates at the exchange. The call currents produced by a magneto machine have no effect upon the galvanometer G, and are thus prevented from passing through G to the relays R at the substations.

Generally the armatures e of all relays R_1 (see Fig. 3) make contact with c. If the exhange desires to call the nth substation, a negative current of such strength is sent into L so as to attract the armatures e of all relays R. The current passes first through S_1, but does not actuate the alarm at the substation, always supposing that alternate currents have been employed. It deflects, however, the needle of the galvanometer G, thus finding a path over v to the relay R_1 and to ground. This path is that of the least resistance, because behind s there are the large resistances W, and as soon as the levers leave c, the apparatus S1 at each station is cut out. Next the exchange transmits a positive current of predetermined strength, say of the value n. This current at first finds no earth ; consequently a ground through w^1 is needed. It is true that this current affects the needle of G, thus introducing at all substations the relays R, but by reason of its strength at this moment it can move only the relay armatures which are at the n stations back from d to c.

Finally the exchange sends a negative current of $(n-1)$ strength to line to replace the armatures e upon d. Thereafter at substation n only the telephonic apparatus S is included in the line and no other station can interrupt the conversation. Upon the close of the conversation the exchange throws the armatures of all the other relays upon c which is accomplished by sending a positive current of sufficient strength over line L_1 L_2. A visual signal may be provided by attaching a small disc to the armatures e.

If a subscriber desires to call the exchange, he proceeds exactly in the same manner as a subscriber having a private line. The call currents enter the exchange without splitting over the other substations, being prevented by the large resistances interposed at the branching points. At the calling station this resistance is removed by means of a key which the subscriber presses while giving the call. If two subscribers on L_1 L_2 desire to communicate, the exchange connects them in any customary manner.

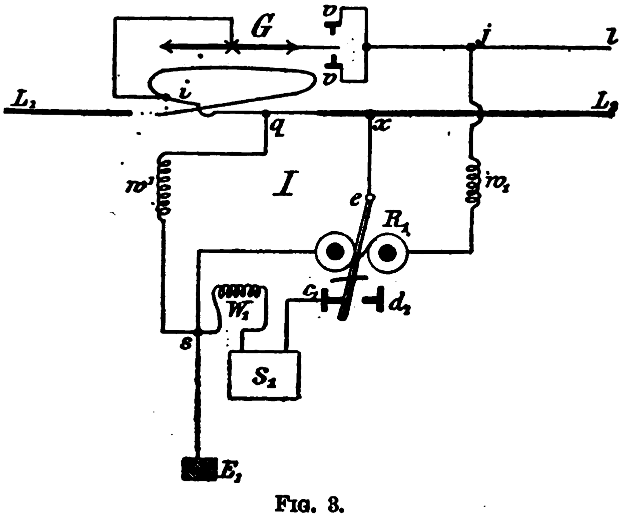


FIG. 3.

In exchanges using complete metallic circuits, G, l, and W_1, Fig. 3, are omitted, while the relays are of identical construction. A light contact spring opposite c must be added to the armature e to ensure the continuance of contact to effect the placing of the armature upon d. In Fig. 4, L_1, L_2, and L^1 L^2 are the metallic line, S the telephone apparatus, and w should be placed between x and n. All substations are similarly arranged. A small key T is added to the axis of the armature e, short-circuiting R, and when pressed, grounding e by means of m. This is necessary whenever a subscriber desires to call. The exchange calls by sending a negative current over L_1 L_2. This current throws all armatures e upon d. Next a positive current of strength n replaces in all n substations the armatures upon c and finally by a negative current of $(n-1)$ strength the $(n-1)$ armatures e are drawn back upon d.

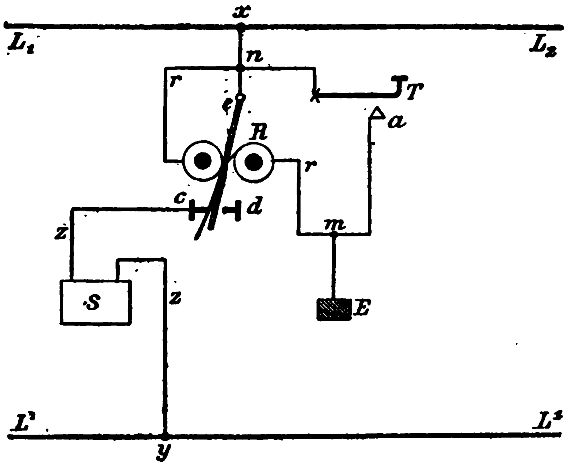


FIG. 4.

THE LIVERPOOL ELEVATED ELECTRIC RAILROAD.

THE *Railway World*, of London, in an account of the car shops of Brown, Marshalls & Co., of Birmingham, prints the following description of a 45-foot passenger car, with an electric motor, now building at those shops for the above-named road: "Each train to run upon the new line will consist of two cars coupled together, and mounted respectively on two four-wheeled bogie trucks of the ordinary American pattern. Upon the truck at each end of the train will be fixed an electric motor of sufficient power (70 to 100 h. p.) to propel the train; but the rearward motor for the time being will alone be in action. The car bodies are 45 feet in length and 8 feet 6 inches wide, the centres of the trucks being 32 feet apart. The truck frames are of pressed steel, and solid wheels, 2 feet 9 inches diameter, are employed, with wrought iron spokes and naves and steel tires. The buffers are placed centrally, as in all American rolling stock, combined with a self-acting car coupler. The motor axle boxes are of cast steel. The car bodies are framed of oak and teak, with side doors, and are separated into two classes only, first and second. The cars are lighted with electricity and are efficiently braked by a mechanical screw brake to every wheel, in addition to the Westinghouse automatic. Each car holds 56 persons; and at one end, immediately above the electric motor, is placed a very neat little cab for the 'motoneer,' with electric regulating switchboard, brakes, etc., close at hand, so that everything is under control."

THE PROFITABLENESS OF UTILIZING EXHAUST STEAM.

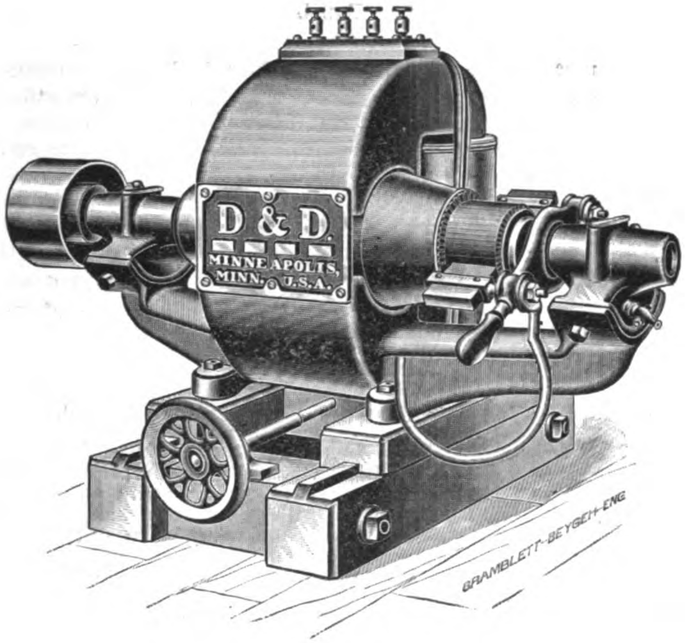
IN its June 1st number THE ELECTRICAL ENGINEER published an illustrated article by Mr. W. F. Collins upon the subject of "The Utilization of Exhaust Steam for Heating by the Springfield, Ill., Electric Light and Power Company."

In support of what was therein said in favor of this plan of turning a waste product into money, we learn that the Springfield Company is so much pleased with its exhaust steam enterprise that it has contracted to have built an extension of its underground steam mains, consisting of one-half mile of six-inch protected iron pipe for further service in disposing of its surplus exhaust steam. The work of construction is being done by the American District Steam Company of Lockport, N. Y.

THE "D. & D." DYNAMOS AND MOTORS.

The appearance of a new dynamo or motor is always interesting to the electrical engineer, not only because of the features of design it may embody, but because it is an evidence of activity in the great field of electric light and power. To-day, particularly, it is felt that a new machine is built to sell on its merits. In the earlier days, pretty well any machine would serve as a basis for the stock jobbing operations then so much in vogue, but at the present time, the new dynamo or motor that would win must appeal for general favor strictly on the ground of superiority in design and efficiency.

This idea has been in the minds of the D. & D. Electric Manufacturing Co. of Minneapolis, Minn., who have recently come upon the market with dynamos and motors of the design and form illustrated in our engraving. These machines, which are well worthy of attention and study, are of the single field magnet type, with a Siemens drum armature, presenting a very substantial and compact appearance, and promising high efficiency. The field magnet which has only two joints, is of wrought iron wound with the best double-covered wire. The pole-pieces, as will be seen, are very heavy. The arms which support the bearings are cast in one piece with the base, and thus secure great stability and strength. The commutator is made of hard copper, with a liberal diameter and width, reducing the wear to a minimum. The insulation is also ample and carefully done. The armature shaft is of the best machine steel. The bearings of these machines are made interchangeable. They are of bronze in the form of a sleeve, turned to gauge. They are also self-oiling. Thorough lubrication is insured by a brass ring, which hangs loosely on the shaft and turns with it. The under part swings through the oil reservoir in its revolution, constantly picks up the oil and feeds it to the bearing; and in due course the oil returns to the reservoir for further indefinite use. The reservoir very seldom needs refilling. The brush holders are of simple design, as will be noted, and are made to carry multiple end-on carbon self-adjusting brushes, so constructed as to give perfect contact between the commutator and each individual carbon block. The centre of gravity in the machine is quite low, so that there is practically no vibration at all in running.



The D. & D. Constant Potential Dynamo.

These dynamos and motors are now wound for 110, 220 and 500 volt constant potential circuits. They are furnished with switchboards for the lighting plants, the boards including double-pole switch, resistance box, fuse blocks, lightning arresters, ground-detector voltmeter and pilot lamp. With each motor is supplied a rheostat or switch box, finished with polished brass switches, binding posts, fuse blocks, etc. It may be stated that the figures of the 500-light dynamo are: 52 inches high; 72 by 48 inches floor space; pulley, 15 inches diameter by 12 inches width; weight 7,090 pounds and speed 800 revolutions. The one-horse motor is 15 inches high; occupies 24 by 14 floor space; has a pulley 3 by 2½ inches; weighs 240 pounds and runs at a speed of 2,500 revolutions.

CALCULATION OF WEIGHT OF COPPER WIRE FOR LONG-DISTANCE TRANSMISSION.

BY

W. F. Hasson.

It is frequently desirable to calculate quickly the weight of copper necessary to transmit a given power to be utilized at the end of the line. This may be done by the following formula, in which

D = distance in miles.
E = E. M. F *at motor* in hundreds.
$H.P.$ = horse power *at motor.*
l = per cent. line loss in units.
W_1 = weight of two copper wires for given distance.

Then

$$W_1 = 267 \times \frac{D^2 \times H.P.}{E^2} \times \frac{100 - l}{l} \text{ lbs.}$$

In order to show the application of the formula, let us take the following example:

To transmit 300 h. p. 15 miles; voltage at motor, 3,000; line loss, 20 per cent.

$$W_1 = 267 \times \frac{15 \times 15 \times 300}{30 \times 30} \times \frac{100 - 20}{20} = 80{,}100 \text{ lbs.}$$

This formula would be quite correct if standard sizes of wire were to be ignored. To find a wire of standard gauge that will meet the above requirements, a table is appended sufficiently accurate and comprehensive for ordinary purposes.

$$\text{Weight of wire per mile} = W_1 = 133.5 \frac{D. \times H.P.}{E^2} \times \frac{100 - l}{l}.$$

Size of wire.	Weight per mile.	Size of wire.	Weight per mile.
Diameter = ½ in.	3,994 lbs,	No. 1 B. & S...	1,337 lbs.
No. 0000 B. & S...	3,381 "	" 2 "	1,061 "
" 000 "	2,682 "	" 3 "	842 "
" 00 "	2,127 "	" 4 "	666 "
" 0 "	1,686 "	" 5 "	529 "
		" 6 " ...	420 "

In the case given above

$$W_1 = 133.5 \times \frac{15 \times 300}{30 \times 30} \times \frac{80}{20} \times 2670.$$

This corresponds to No. 000 wire; and W_1 corrected becomes 2682 × 30 = 80,470 lbs.

In these examples no allowance is made for sag.

THE LOVE ELECTRIC CONDUIT SYSTEM IN CHICAGO.

There is considerable public interest in conduit electric railway systems at the present time, with very little to satisfy the curious or to stimulate the energies of the hopeful. In fact, we believe that the only conduit system that is "operative" in the United States to-day is the Love, under trial on the North Chicago street railroad. The Love Electric Traction Co. is a Chicago corporation, which last February equipped a loop about 1½ miles long for the North Chicago road. We are indebted to the *Railroad Gazette* for the details as to the conduit there used, as shown in Figs. 1 and 2. The construction of this conduit road is quite similar to that of the usual cable road. It has cast iron yokes spaced about 4 feet apart and a cast iron conduit about 9 inches wide and 15 inches deep. The top cover of the conduit consists of rolled steel angles having a deep vertical flange on the side next to the slot. These flanged rails are cut into lengths of about 30 feet each and are so constructed and laid that they can be taken up at any time, giving free access to the interior of the conduit for purposes of repair or for the removal of dirt or other obstructions that may fall into the conduit. The slot rail is made to serve a two-fold purpose; it defines the slot and protects the copper wire conductors from outside interference. There are two copper wires about ⅜ inch diameter spaced about 6 inches apart for carrying the current. The trolley bar is a very simple device. The trolley wheels are slightly smaller than those used in overhead roads, and are so suspended from the trolley bar that they admit of all necessary vertical and horizontal motions due to the irregularities of the line and in passing curves. The trolley bar is so constructed that it can be readily detached from the car or replaced.

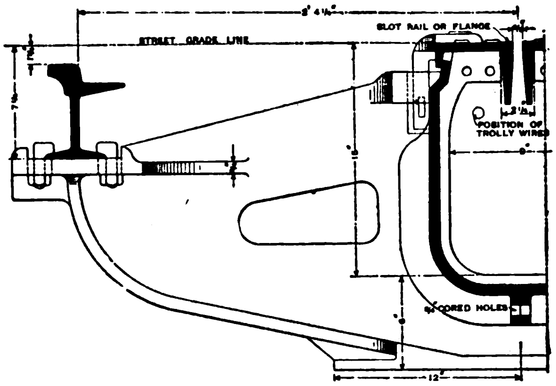


Fig. 1.—Love Electric Conduit for Street Railroad—Cross-Section.

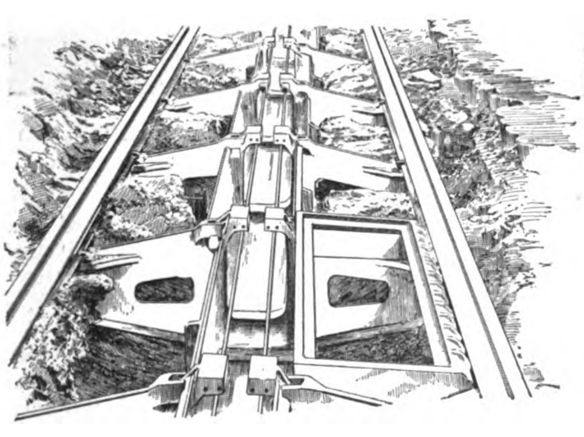


Fig. 2.—The Love Electric Railway Conduit.

During the heavy rainstorms in Chicago in the months of May and June this road was severely taxed, as in some places the streets were covered to a depth of three or four inches with water, filling the conduits. Notwithstanding the presence of water in the conduits, the running of the road was not interfered with. This road was put in as an experiment, but it has been so successful that the North Chicago Street Railway Co. has bought it, being well satisfied with the service rendered. Nineteen miles of this electric conduit system is negotiated for in Washington and Baltimore this year, and it is expected to have the lines in running order within six months.

The plant in Chicago for generating the current consists of one Edison dynamo, and a high speed "Ideal" engine. The two motor cars are equipped with Westinghouse motors. These two cars supersede about 110 horses, 60 being on the line constantly. The per diem cost for fuel and help at the power station is said to be very low. The repairs to trolley and other details have been reasonable so far.

THE ELIHU THOMSON PRIZE.

At the last prize contest instituted by the city of Paris for the best electric meter the prize of 5,000 francs was awarded to Prof. Elihu Thomson.

With the desire that this sum should serve for the development of the theoretical knowledge of electricity, he has requested the undersigned, general manager for Europe of the Thomson-Houston International Electric Co., to offer a prize for the best work on a theoretical question in electricity, and to organize a committee who should propose the subjects, examine the productions and award the prize.

The following gentlemen have been chosen, and have kindly consented to act as members of the committee: J. Carpentier, president of the Société Internationale des Electriciens; Hippolyte Fontaine; E. Hospitalier, professor in the School of Physics and Chemistry of the city of Paris; E. Mascart, member of the Institute; A. Potier, member of the Institute, examiner; B. Abdank-Abakanowicz, consulting engineer, secretary of the committee.

The committee has decided that the prize should be given for an investigation on one of the following subjects:

1. The heat developed by successive charges and discharges of condensers under different conditions of frequency, nature of dielectric and quantity of charge.
2. It has been shown theoretically that when the two surfaces of a condenser are connected by a conducting body, the condenser becomes the source of alternating currents as soon as the resistance of the conducting body decreases below a certain limit. The formula that permits calculating the period of this oscillation has not yet been completely verified. This period of oscillation should be investigated experimentally under conditions such that the exact measure of resistance, capacity and coefficients of self-induction may be possible, in order to arrive at a complete and precise verification of this formula.
3. When a condenser made with an imperfect insulating material has been charged and then left to itself, the charge is gradually dissipated. The time necessary for the charge to be reduced to a given fraction of its initial value depends only on the nature of the insulating material. It is proposed to investigate whether, as certain recent theories would seem to indicate, analogous phenomena do not present themselves in metallic conductors, and whether these can be shown experimentally.
4. It is proposed to arrange and systematize our present knowledge of the graphical solutions of electrical problems, and deduce from them some general methods as in graphical statics.

The theses presented may be written in any one of the following languages: English, French, German, Italian, Spanish or Latin. They may be in manuscript or printed.

Each thesis presented must be signed by a pseudonym and accompanied by a sealed envelope bearing the same pseudonym on the outside, and with the name and address of the author inside.

The papers must be sent before the 15th September, 1893, to B. Abdank-Abakanowicz, consulting engineer, the secretary of the committee, at 7 Rue du Louvre, Paris, who will furnish any further information required.

Ernst Thurnauer.

Paris, September 1, 1892.

THE SUCCESSFUL TRIAL TRIP OF THE UNION ELECTRIC COMPANY'S ELECTRIC LAUNCH "VASHTI."

ACCEPTING the invitation of the Union Electric Company to witness a trial trip of the "Vashti," a party of gentlemen representing the electrical and daily press, made a trip to Nyack by rail on Thursday last, Sept. 15. The party were driven to the boat-house of the Nyack Rowing Association, where the little craft was boarded. A delightful sail of nearly twenty miles around Tappan Zee was indulged in, which occupied about two hours. The behavior of the launch was everything that could be desired. Vibrations were almost imperceptible. She is a splendid little sea boat, as shown by her behavior when a "trough" was encountered in crossing the large bay from the picturesque headland, Hook Mountain, to Sing Sing, thence to Tarrytown and again across to Nyack. There was not the least "hitch" to mar the pleasure of the entire trip or to make the test anything but a success. Everything was perfectly new and untried, as the little vessel had been in the water but three days before this trial. Evidently storage batteries are "in it."

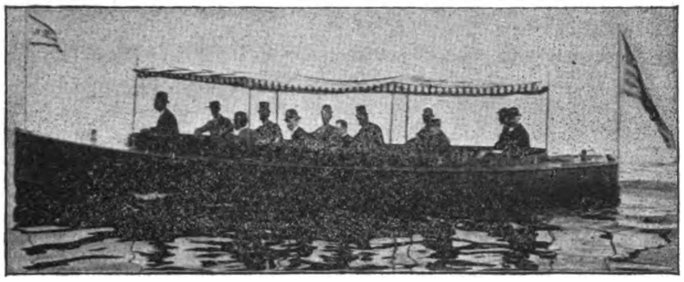


FIG. 1.—SIDE VIEW OF THE ELECTRIC LAUNCH "VASHTI."

After disembarking, the party were gracefully entertained at lunch by Mr. S. R. Bradley, Jr., secretary of the company. Suffice it to say, after the pleasant hours spent on the water, ample justice was done this latter portion of "the test."

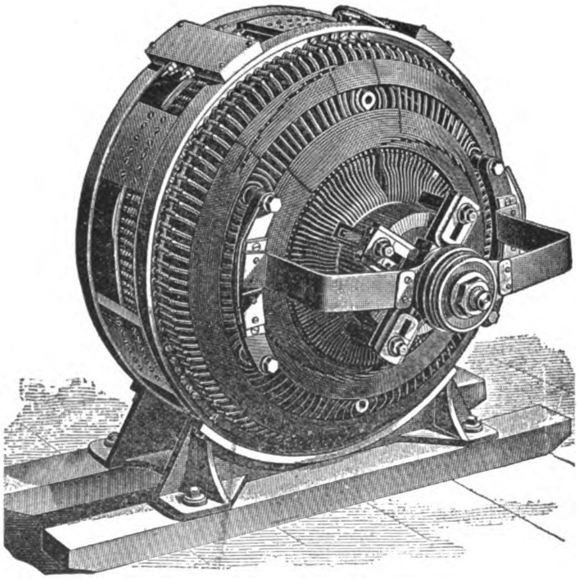


FIG. 3.—THE MAIN MOTOR.

THE "Vashti" is 30 feet long over all, with 6 foot 6 inch, beam, and has a draught of 2 feet of water. She can comfortably seat at least 26 persons. Her frames are of oak and she is planked with carefully selected cedar. She was built at the yards of Chas. L. Seabury & Co., of Nyack, under contract with Mr. S. R. Bradley, president of the Union Electric Co., of 45 Broadway, New York and is built from the same model as the steam launch of W. K. Vanderbilt, the "Alva." An almost incredible point is that although only having a length of 30 feet, this boat has a clear cockpit of some 23 feet.

Fig. 1 shows a full length view of the boat with Prof. Main at the wheel, and Fig. 2 shows also the current-controlling devices a description of which is here given. This controlling device is also the special design of Prof. Main, and is ingenious and simple and can be operated by a child. This portion of the apparatus is placed just under the forward deck, under the steering wheel, and where it is impossible for water to reach it. The person steering the boat operates this easily and at the same time. This device consists of a double-throw switch and rheostat with convenient wordings "ahead" and "back" on their proper sides of the dial. There are seven contacts on either side for increasing or decreasing speed. All this is on one shaft, and is manipulated by means of a small nickel-plated hand wheel. The voltmeter and amperemeter are placed one on each side of the rheostat dial. One switch cuts in one set or one-half the battery, while another throws in the whole 72 cells.

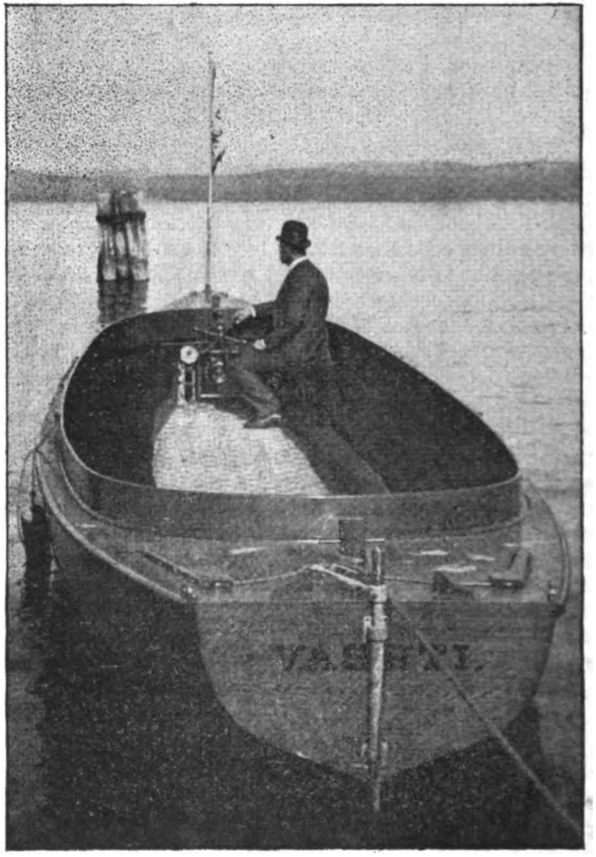


FIG. 2.—END ON VIEW OF ELECTRIC LAUNCH "VASHTI."

The motive power of the launch consists of an installation of 72 storage batteries (Main type), a cut of which appears in the advertising pages of this journal, the only difference being that in those used on the launch, the cell cases are of hard rubber. These cells are evenly distributed on either side of the keel of the boat, and immediately under her floorings on a false bottom or platform. This arrangement of what really constitutes the ballast of the boat is admirable, placing as it does all the weight below the water line and thereby making a wonderfully steady boat, as well as leaving at least 44 feet of locker room. The motor is also placed beneath the floor, and sits in a large copper jacket which protects it from any possible splashings or leakings. The motor Fig. 3, is specially constructed of the Main type with 5 h. p. capacity, manufactured by the Union Electric Works, with revolving brushes (carbon) and poles. A special device has been introduced by Prof. Main, by which the contact of the brushes on the commutator is neatly regulated. The brushes are held in a slot and a counter weight or compensator increases or decreases the brush contact as the centrifugal force increases or decreases. The motor and propeller shaft are direct coupled, the shaft thrust being a ball-bearing running in oil. The propeller is a three-flange wheel with 20 inch pitch. The weight of the motor is about 600 pounds and it has a very slow speed. At a speed of 400 revolutions the boat makes easily eight miles per hour.

THE SUBMARINE CABLE REQUIRED FOR LAKE HURON.

IN view of the great interest taken in the recent discussion in the columns of THE ELECTRICAL ENGINEER as to the proposed purchase of submarine cable by the United States Government for the use of the Signal Service on Lake Huron, we deem it worth while to print the specification, a copy of which has been courteously furnished us by Prof. Mark W. Harrington, Chief of the Weather Bureau. It will be seen that, as was suggested, the appropriation of $31,000 asked from Congress is intended to include the cost of laying the cable. The bids are to be opened at Washington at 11 a. m., Friday, September 30.

SPECIFICATIONS AND CONDITIONS FOR

furnishing and delivering or furnishing, delivering and laying, about six and one-half (6½) statute miles of one-conductor submarine telegraph cables. One piece to be laid from Thunder Bay Island to the main land, about 4 statute miles; and one piece from Middle Island to the main land, about 2½ statute miles. Said islands being located in Lake Huron, about 12 miles northeast and 15 miles east, respectively, from the city of Alpena, Mich.

SPECIFICATIONS.

1.-*Conductor.*—The conductor to be formed of a strand of seven copper wires, each No. 22 B. & S. gauge, of the best quality and manufacture, and of a conductivity not less than 96 per cent. pure copper. The resistance of the conductor to be not more than 12.20 ohms per statute mile (1,760 yards) at a temperature of 70 degrees Fahrenheit.

2.-*Insulation.*—The interstices in the conductor to be filled with Chatterton's compound, and the whole covered with three coatings of best gutta-percha, to be applied so as to be entirely homogeneous to a diameter of 0.26 inch, and give an insulation resistance of not less than 400 megohms per statute mile, after being submerged in water for 48 hours at a temperature of 70 degrees Fahrenheit.

3.-*Serving.*—The core to be served with three layers of best tarred jute, of proper thickness.

4.-*Armor.*—The served core to be armored with 12 No. 5, B. W. G., Best-Best galvanized iron wires, spirally laid.

CONDITIONS.

A sample is desired with each bid, if practicable.

Preference will be given to bids to furnish the cable laid, but bids will also be entertained for the cable delivered at Alpena, Mich.

Bids should state the cost per statute mile of cable delivered at Alpena, Mich., and, separately, the cost of laying the cable between the points named.

The cable is desired as soon as practicable, and each bidder must state the time within which it will be furnished.

The cable should have as few joints as practicable, and the bidder will specify whether the two sections will be delivered whole or in how many pieces.

The cable should be wound on reels of such construction and strength as to be used in laying it.

The cable is to be subject to such inspection and tests as the bureau may consider necessary, either before or after laying, or both; and if laid by the bidder, will be laid over such general course as may be indicated by an agent of the Weather Bureau, in the deepest water. The shore ends to be buried under ground from a point where the water is four feet deep to the foot of the cable pole, where it will be brought up, made fast to the pole and ready for connecting into a cable box. The cable will not be less than two feet under ground on shore, nor less than four feet from the surface in the water.

If laid by the bidder, an agent of the Weather Bureau will be present on the vessel and elsewhere, to see that the work is done according to the true intent and meaning of the contract.

All materials used to be of best quality, and all work to be done in the best manner and within the time specified by the accepted bidder.

The necessary instruments and batteries for testing the cables before and after laying must be provided by the contractor.

Patent Notes.

PROF. THOMSON'S ALTERNATING CURRENT TELEPHONE SYSTEM.

IN a patent just issued to Prof. Elihu Thomson, this well-known inventor describes a system of telephone in which alternating currents are employed in the primary of the induction coils to which the transmitter is connected instead of continuous currents, as now generally employed. In applying the alternating current for this purpose, Prof. Thomson employs such a low rate of alternation as not seriously to interfere with speech.

The alternations, generated by an alternator, are induced into the subscribers' lines and form the means for transmission from the subscribers' lines to other subscribers' lines, to which they may for the time being be connected through the exchange. The rate of alternations is as low as 32 vibrations per second, and even those below sixteen vibrations per second are available. These rates of vibration or alternation are so low that although the instruments are subjected to them they do not seriously interfere with speech, as the tone they produce is almost inaudible on account of the small volume of air set in motion by the diaphragms of the instrument.

By means of this system, all local batteries at the subscriber's end of the line are dispensed with, and the system is, as it were, a closed circuit system possessing great flexibility. The system also permits the working of the annunciators at the exchange by the subscriber momentarily opening the line by a switch, or, better, by the simple act of lifting the telephone from the hook, while the replacing of the telephone on the hook again signals the exchange that the use of the line is discontinued. The system also provides circuits, so that there shall not be any circuits actually grounded, as connections to earth through condensers may be made instead of returning through a continuous conductor or a metallic circuit connected to earth, such as is ordinarily employed.

Reports of Companies.

IMPORTANT ACTION OF THE WESTERN UNION CO. INCREASING CAPITAL STOCK.

THE WESTERN UNION TELEGRAPH COMPANY has declared a quarterly dividend of 1¼ per cent., payable Oct. 15. The board of directors have adopted resolutions recommended by the executive committee, authorizing and directing proper steps to be taken for an increase of $18,800,000 to the capital stock of the company, making the aggregate capital stock $100,000,000, to be issued at such time or times and for such lawful considerations as the board of directors may thereafter direct and determine. A special meeting of the stockholders will be held on October 25, to vote upon this proposition. The regular annual meeting of the stockholders will be held on October 12, and the transfer books for that event and for the payment of the dividend will be closed on Sept. 20. It is understood that $8,620,000 of the new stock will, if authorized, be used to pay the shareholders a scrip dividend of 10 per cent. to represent net earnings diverted from them and expended in making additions to the property. The remaining $5,600,000 will be held in the treasury of the company. For the quarter ending Sept. 30 the company reports partly estimated earnings as follows:

	1892.	1891.
Net revenue	$2,200,000	$2,000,000
Interest and sinking fund	242,960	242,388
Balance	$1,957,040	$1,757,612
Dividend	1,077,410	1,077,405
Surplus	$879,630	$680,207
Total surplus	14,455,757	12,097,948

From the quarterly reports issued by the company an approximate statement of the results for the year ending Sept. 30 shows:

	1892.	1891.
Net revenue	$7,398,545	$6,605,583
Interest and sinking fund	970 523	931,218
Balance	$6,428.022	$5,674,365
Dividends	4,309,637	4,309,606
Surplus	$2,118,385	$1,364,759

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE Institute will hold its first meeting of the season on Sept. 27, at 12 West Thirty-first street, when Mr. Charles Steinmetz will read a most important paper on "The Law of Hysteresis." The report on the election of officers will be brought up, and members will be invited to contribute notes of their electrical vacation experiences.

E. J. HALL, SR.

THE sudden death is announced of Mr. E. J. Hall, Sr., who has long been prominently and actively connected with telephone interests in Buffalo and Rochester. He had been ailing for some time past. Mr. E. J. Hall, Jr., the well known executive of the American Telegraph and Telephone Co., (Long Distance) in this city, is his son.

Literature.

The Law of Incorporated Companies Operating Under Municipal Franchises. By Allen Ripley Foote and Charles E. Everett. Cincinnati, *Robert Clarke & Co.*, 1892. Price, $10. (Advance sheets.)

THIS book embodying as it does the economic legislation of all the American States, so far as it relates to companies operating under municipal franchises, is a most timely, important and valuable publication. Just to what extent legislation is now occupied with questions of this nature is not well known, but it must be very considerable. In America it is of greater scope than in any other country for the reason that here, thanks to the primal conditions of Statehood, scientific home rule prevails, and each community settles for itself matters that elsewhere are heaped upon an overburdened Imperial legislature, which lets them drag along. The result of our system is that, while with greater freedom, we have an undue variety of treatment, the public will is more directly and immediately in control of the privileges that it confers. The precedent established thus in our federal system of government broadens down through all the methods of economic legislation, so that, not to put it too broadly, we will often find a New England community disposing in an hour of a question that in Old England will block action at Westminster for a whole session and even turn out a strong Administration.

But even where the principle of individual decision is most clearly seen, as in this country, it is evident that certain ideas and feelings may so permeate a nation as to be governing in even its most 'independent and widely scattered communities. It thus becomes necessary, or at least desirable, to ascertain just what the conditions prevalent in legislation are; whether different kinds of franchises are subject to different limitations or whether a uniformity of practice obtains; what return to the community is expected for favors granted; whether there is a growing jealousy of such corporations or whether they flourish under a benign sun of liberality. America is most certainly the best field in which to study the manifestations of the popular will towards companies operating under municipal franchises; and the book before us is in effect an analysis and summary of State and Municipal policy relating thereto.

Electrical investments are peculiarly susceptible to the influences of legislation for the reason that a very large number of electrical inventions are strictly public servitors. If we mention simply the telegraph, the telephone, the electric light and the electric railway, how large a sphere of industrial and inventive development is at once covered; and all these inventions can only be availed of under the operation of State laws and municipal franchises. Now, as we look around, do we find that electrical enterprises make greater headway in one State than another; and if so, is not the reason to be found in the more generous treatment by the State of those whom it invites to invest their capital, under its protection, in enterprises from which the mass of its citizens shall reap notable advantages? This is a vital question, and only with the aid of such a book as this can it be answered.

After all, the modern conception of the relation between the State and these local companies that supply water, electricity, gas, locomotion, etc., is the highest and best realization we yet have of the principle of co-operation. Every time that a corporation is formed to render some public service, under certain conditions that the State or municipality imposes, each and all of the citizens become partners in the enterprise, interested in its welfare and prosperity. It cannot well be otherwise, even though the citizen often enjoys in more senses than one an unearned increment. Sometimes—often perhaps—the corporation makes a bargain that is unreasonably profitable to its immediate stockholders; but not less frequently may be seen the development in wealth and prosperity of a community by a corporation that has not been given the slightest local encouragement and that has to struggle for years against small returns, when by a more restricted outlay at the start it might have made money very quickly. There has apparently been gaining ground an idea that these local services can best be rendered to a community by itself, on borrowed capital and with the aid of sundry new bureaus and departments; and the newer electrical enterprises have been a special point of attack by persons holding such opinions. Hence to-day we find a number of communities which instead of issuing franchises that bring a return, issue bonds that mean heavier taxation. On the whole, however, it may be doubted whether this economic heresy is winning many adherents; and the inference to be drawn from a study of this volume deepens the doubt. There do appear, nevertheless, two tendencies; one looking toward control; the other looking toward the exaction of a larger price for the franchise granted. The former process will probably continue. The State must be master and its supervision must keep pace with the growth of corporations in elements of power. The fact that it delegates to these corporations certain of the functions that the present condition of society requires the performance of, does not excuse it from vigilance on behalf of its citizens. But on the other hand, so long as it enjoys an active voice in the management of these quasi-public properties, the community is beginning to find out that it is better to go slow in making a company pay dearly for its franchise. It may be accepted as an axiom that the higher the price paid for the franchise, the lower will be the quality of the service rendered.

Many considerations of this nature, as well as others, are set forth by Mr. Foote in his thoughtful discussion of the principles involved. We do not at all points agree with him; at some, our disagreement is extreme; but in the main his work is very well done, and his masterly plea for a broad and liberal treatment by the public of itself as embraced in corporate forms, will stand. For the rest, it may be stated that Mr. Everett is an admirable editor of the legal part of the work, and that he has had splendid assistance from the forty-six attorneys who have prepared the digest of corporate legislation in each State. It is said that $20,000 has been spent on the preparation of the book. We can readily believe it, and we are equally ready to believe that everywhere the subscriptions for it will be liberal enough to fully indemnify and reward Mr. Foote, his publishers and his colaborers. The book is one that should be in the office of every local company, every mayor, every city clerk, and every lawyer who has to deal with questions of municipal franchise.

It remains to add that when complete, the work will be contained in two volumes of about 1,400 pages each. Delivery to subscribers will be made in October.

The Law of Electric Wires in Streets and Highways. By Edward Quinton Keasby, of the New Jersey Bar. Chicago, Ill. *Callaghan & Co.* 1892. 8vo. pp. 190 + xi. $3.50.

The author of this work, in his preface, claims to have undertaken nothing more than to collect and examine the reported decisions, with a view of ascertaining how the principles of the laws relating to streets and highways have been applied to the new and perplexing conditions which have arisen within the past few years, from the necessary use and occupancy of these thoroughfares of electric lines. He has not attempted, nor indeed would it have been useful for him to have attempted, to produce a treatise on the subject. The legal controversies relating to these matters have nearly all arisen within the past ten years, and there has been no little conflict, up to the present moment, between the decisions of different tribunals. To the mind of the layman it would almost appear as if nothing had been conclusively settled in reference to some of the matters principally in controversy, but Mr. Keasby, while for the most part very conservative in the expression of his own views, has sometimes felt justified in indicating the conclusions to which the reasoning of the courts appear to point. While therefore, the work, from a legal point of view can be regarded as little more than a digest of the reported decisions, it nevertheless appears to embody about all that could be said, or that it would be profitable to say, at the present moment.

Lord Coke has said: "Reason is the life of the law—nay, the common law itself is nothing else but reason; which is to be understood of an artificial perfection of reason gotten by long study, observation and experience, and not of every man's natural reason." In other words the broad and comprehensive principles of the common law, founded on reason, natural justice and enlightened public policy are adapted to practical use in particular cases by general usage, which evinces their fitness and convenience, and are then made precise and specific by judicial exposition. "The consequence of this state of law is," in the words of Chief Justice Shaw, "that when a new practice or a new course of business arises, the rights and duties of parties are not without a law to govern them; the general considerations of reason, justice and policy, which underlie the particular rules of the common law, will still apply modified and adapted by the same considerations, to the new circumstances. If these are such as to give rise to controversy and litigation, they soon, like previous cases, come to be settled by judicial exposition, and the principles thus settled soon come to have the effect of precise and practical rules." We find accordingly, that an examination of the cases which Mr. Keasby has industriously collected and annotated reveals much of interest as showing how the judicial mind has grappled with the various and oftentimes perplexing questions which have arisen.

"The rights in the streets," says Mr. Keasby, "are both public and private. They are opened for public use, and yet the title to the land, subject to this use, remains in private owners, or else the owners of adjoining lands have a right of property in having the road kept as a road for the public purposes to which it is devoted. The present discussion, therefore, involves the consideration of what are the proper uses of the street, and how far these are subserved by the various uses of electric wires, and also what are the public or private rights with respect to the streets and to the use of them for these purposes." The branch of the above inquiry as to public rights, relates mainly to the authority under which streets and highways may be occupied by poles and wires, while, in respect to private rights, it becomes necessary to ascertain whether the various uses of electric wires in the streets affect these rights, either as imposing a new burden upon the land or as trespassing upon the rights of abutting land owners in the street to such an extent that compensation must be made. Incidental to this branch of the inquiry are the frequently occurring controversies between the telephone companies and the electric lighting and railway companies, arising out of the interference of electric currents, due to the use by both, of the earth as a return conductor.

In the necessarily brief space at our disposal, we can only refer to some of the most important of these questions which have come before the courts for adjudication. It has been well settled that the use of the streets belongs solely to the public; that the legislature represents the public, and hence, that a municipality can have no control over the streets other than that which has been given to it by the legislature, either expressly or by implication. It follows from this that a municipality can have no power to grant exclusive franchises or permanent privileges. The legislature, however, within the limits prescribed by the constitution, may grant exclusive, indefinite, and irrevocable franchises for the use of the streets. In case the legislature has authorized the construction and operation of a street railway, and perhaps also the employment of electric motors for operating such railway, the question has frequently arisen as to how far the municipal authorities may permit, or may regulate, the construction of a system of overhead wires for supplying electricity? A number of cases involving this point have been decided, in which overhead wires had not been expressly authorized by the legislature, and in some cases not even by municipal ordinance. The trend of judicial opinion appears to be, that the municipality, by virtue of its power to regulate the use of the streets, may determine whether or not any particular structure is or is not in fact an obstruction to the free public use of the street. It has even been held in a case in California, that a municipality may prohibit the placing of electric wires over or across the roofs of buildings, on the ground that the practice is dangerous "both as being likely to originate fires and as interfering with the extinguishment of fires otherwise originated."

The greater number of controversies of late have arisen between the electrical companies and land owners, in consequence of the enormous multiplication, during the past few years, of overhead wires for various purposes. So long as electric lines were confined mainly to telegraphs along country roads, few such contentions arose, and it is therefore not surprising to find that although the telegraph has been in use for 50 years, scarcely a decision involving this question is reported prior to 1883. But with the daily increasing new uses of wires, the enormous increase in their numbers, and the introduction of the element of danger to life and property attending the use of powerful currents for electric lighting and other purposes, aided and abetted by a senseless newspaper clamor, a determined opposition to all overhead wires has been developed on the part of owners and occupiers of land, so that there have been many decisions within the past two years, as to whether an abutting owner may legally object to the erection of poles and wires in the street, especially for the purpose of propelling street cars. For a time the courts manifested a tendency to make the conclusion turn upon the question whether the fee of the land embraced in the street, was vested in the municipality or in the abutting owner. This aspect of the question however, appears to have been thoroughly threshed out and settled in the "elevated railroad cases" in New York, and the weight of opinion at the present time clearly is that the abutter, whether owner of the fee or not, has a right to light, air and free access to his property, which cannot be taken from him without compensation. There can be no doubt that the doctrine of all the decisions is to the effect that the adjacent owner has redress for any substantial obstruction of his right of access, or of interference with his free enjoyment of the use of the street. As to the right to plant poles without the land owner's consent, where there is no actual interference with access, or with light and air, there is still much difference of opinion. With the extension of the conveniences required by modern civilization there must necessarily be an enlargement of the uses to which the streets are put, and as Mr. Keasby points out, so long as these enlargements serve the public convenience, and do not diminish the actual use and enjoyment of the land owner, there would seem to be no reason on principle why the land owner should have a right to object, since in any event he could only be entitled to recover nominal and not actual damages. The real issue therefore, resolves itself into an inquiry whether the use of the electric cars, and of the poles and wires necessary to their operation in any particular case, does in fact interfere with the free use of the street in connection with the adjacent land, or diminish the value of such land by changing its relation to the street.

The most interesting as well as the most difficult phase of the whole controversy, is that which relates to the interference by electric light and railway currents with the ordinary use of the telephone. The telephone companies, being well provided with the sinews of war, have naturally enough resented the intrusion of both these newcomers with vigor, and not without effect. In the last-named instance the current has been applied to the legitimate purposes of the street railway, a prior occupant of the streets, and moreover, the electric railway, being used for the purposes of public travel, has in any case, as a matter of principle, a better claim of right to the use of the streets than the telephone wires. There has been much litigation on this subject in the inferior courts, but an examination of the decisions which have been collected by Mr. Keasby, shows that considerable difference of opinion still prevails as to the legal relations of the conflicting interests. It seems clear, however, that the courts are not disposed to exercise the power of injunction beyond what is necessary to avoid present injury to existing property, and it is by no means certain that it will be exercised even to that extent. It may be that the courts will ultimately take the ground that every one using electric force in the public streets must protect himself, by his own ingenuity, from interferences arising from the lawful uses of the same force by others. It is certain that the public convenience will demand that the thoroughfares shall be alike open to the use of all the electric currents that may be required, and as Mr. Keasby pertinently observes, "it seems likely that the settlement will be made through the ingenuity of inventors rather than by the efforts of lawyers and judges."

A considerable number of cases are reported growing out of the well-remembered conflicts between the Western Union and the American Union and Baltimore and Ohio Telegraph Companies, in reference to the exclusive grants of rights of way given to certain telegraph companies along railway lines. The case of *Pensacola Telegraph Co.* vs. *Western Union Telegraph Co.* arose under an act of the legislature of Florida purporting to give the former an exclusive right to erect telegraph lines in certain counties. The Supreme Court decided that this act was in conflict with the act of Congress of 1866, giving all telegraph companies under certain conditions, the right of way over all military or post roads in the United States. It appears from subsequent decisions that the real effect of this act is to deny any particular telegraph company the right to acquire any such easement in the lands of a railroad for telegraph facilities, as to exclude other companies from obtaining like privileges. Upon principle it would seem, therefore, to prohibit any railway company from making such an exclusive contract with one telegraph company as to debar itself from the right to make a similar contract with a rival company.

There are many other minor points of interest involved in the cases reported, reference to which must be omitted for lack of space. It is only necessary to add that the particular work which Mr. Keasby has undertaken to do, has been done conscientiously and intelligently. We can recall no decision, up to a very recent date, which has escaped his attention. Some compilation of this kind has become a necessity to all officers of corporations which have occasion to construct or use electric conductors in the public streets and highways. We can but express the hope that when the evolution of the subject has progressed far enough to render it possible to write a systematic treatise upon the law of electric conductors, that the work may fall to the lot of at least as accurate and careful an author as Mr. Keasby.

Letters to the Editor.

"CONTINUATOR," "PULSATOR," ETC.

It was with pleasure that I noticed the criticism of Mr. Tyler in the last issue of The Electrical Engineer, and while I, myself, would like to hear shorter and more appropriate names, it seems to me that the arguments or reasons given are not quite to the point. At present we understand by the words "continuous current generator" only a *dynamo which is capable of maintaining through an external circuit* an electric current, the impulses of which follow each other quick enough to be considered as an even flow. We do not understand by "continuous current generator" a dynamo which will originally generate continuous currents. It is well known that all commercial machines, built up to the present, are alternate current generators, with two or more contact terminals attached thereto, depending on the purpose for which they are required.

The same remarks apply to a pulsating current generator. An alternating current generator, or alternator, can be construed in the way indicated by Mr. Tyler, and from this standpoint the name "continuous current generator" would have been more appropriate for chemical batteries. It is well known to engineers that the names for the dynamo types under consideration are misleading and incorrect if construed in the way Mr. Tyler does. His objections would fall primarily upon the nature of the dynamo and upon the old names. The latter, in spite of their admitted weakness, are so well known that it would not be wise to change them so far as to lose their origin. It was not the intention to find names which could mean "that the apparatus, so called, *generate* the currents pulsated or continuated." It is the rule to name a device by the work it has to do, and not by the processes it has to perform to reach the final result, and this view justifies the old names. We speak of an arc light or incandescent light dynamo or generator, not because they generate the lights, but operate them in the external circuit; we speak of converters, transformers, secondary generators, because we take the external circuits always into consideration, and with the same right we can construe a continuous current generator or pulsating current generator, a dynamo adapted to maintain through an external circuit, respectively, a continuous current, or a pulsating current flow. Construed in this light, both the old and the proposed names are characteristic of the nature of the current used to operate devices.

The advantage in construing the generators in the light just named will be seen, as it overcomes the just criticisms raised. Mr. Tyler says: "These names will equally as well refer to purely mechanical or non-generating devices—and there are several—which are used to pulsate a continuous current, and to continuate a pulsating one."

These names cannot be construed in the light Mr. Tyler mentioned, but are characteristic and correct, if we consider the system to consist of the generator on one hand, and the external circuit on the other. The commutators or mechanical devices referred to by him are invariably located in the external circuit, while in a dynamo the external circuits begin at the brushes. The commutator, therefore, forms the terminals of the wires which constitute an element in the generator. A battery and a Ruhmkorff coil may serve as a comparison.

I hardly think that any one would call a "pulsator" a primary battery in connection with an interrupter. The interrupter has never the close connection with the battery, as a commutator to the armature winding; the difference is that the one forms part of the machine proper while the other forms part of the external circuit.

For mechanical devices, *separate* from the generator, we have the following names: Switch, pole changer, commutator; to which we could add "current dresser." For devices adapted to cause pulsations we have "vibrator" and "interrupter," to which we could add "fluctuator."

The objections raised by Mr. Tyler hold good only as long as a proper distinction is not made, or as long as a definition is not given. The less common names may be applied to devices not frequently used, such as "pole changer" or "current dresser," vibrator or fluctuator respectively, while the shortest ones, and especially those which easily disclose their origin, should be retained for the generators or more common devices, as for instance, *continuous* current gener*ator* or *continuator*, *pulsat*ing current gener*ator*, or *pulsator*.

LUDWIG GUTMANN.

CLEVELAND, OHIO, Sept. 3, 1892.

WHY UNIPOLAR DYNAMOS DON'T WORK.

MR. S. W. BALCH in his interesting article on "Twisting Magnetism," printed in THE ELECTRICAL ENGINEER of Sept. 14, seems to be at a loss for an explanation, why his machine did not yield any current whatever.

Unfortunately he has, in common with very many other inventors of unipolar dynamos overlooked a very important fact. It may perhaps save some future inventors in that field from disappointment and loss, if this fact is again pointed out with some emphasis, and in order to do this, I can do no better than to quote the following sentences from Silvanus Thompson's "Dynamo-Electric Machinery," viz: "It is, however, necessary that the moving conductor should, in its motion, so cut the magnetic lines as to alter the number of lines of force that pass through the circuit of which the moving conductor forms part. * * * If the coil be moved by a motion of translation to another part of the uniform field, as many lines of force will be left behind as are gained in advancing from its first to its second position, and there will be no current generated in the coil."

D. C. REUSCH.

NEW YORK CITY, Sept. 14, 1892.

Society and Club Notes.

ANNUAL MEETING OF THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

THE annual meeting of the American Electro-Therapeutic Association will be held in this city, at the Academy of Medicine, on October 4th, 5th and 6th. The president is Dr. William J. Morton, of New York; secretary, Dr. Horatio R. Bigelow, 1776 Chestnut street, Philadelphia. The New York committee of arrangements are Drs. Robert Newman and A. H. Goelet. The programme will consist of scientific papers and discussions, and reports of committees appointed last year to secure uniformity in the manufacture and use of certain instruments used in electrotherapeutics. Prof. E. J. Houston is also to contribute a paper on "Cataphoresis," and Mr. J. J. Carty will discuss electro-therapeutics from the standpoint of the electrician.

There will be an exhibition of batteries, instruments and appliances used in medical and surgical electricity. The New York Electric Club will give the association a reception on October 4.

Inventors' Record.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED SEPT. 6, 1892.

Accumulators:—

Storage Battery, P. Kennedy & C. J. Diss, Brooklyn, N. Y., 482,043. Filed Sept. 25, 1891.

Employs a non-conducting grid for holding the active material and conductors connecting the different sections.

Storage Battery, P. Kennedy & C. J. Diss, Brooklyn, N. Y., 482,044. Filed Sept. 25, 1891.

A structure for holding the active material composed of cohesive bitumen, resin, gum or gum-resin and a mineral non-conductor of electricity.

Alarms and Signals:—

Electric Fire and Burglar Alarm Connection, H. T. Wilson, Louisville, Ky., 481,989. Filed June 9, 1892.

Employs a spring blade bent into the form of a loop and filled with a melting composition normally holding the circuit open.

Train Signaling Apparatus, J. M. Henry, Wilmerding, Pa., & R. B. Wilson, Altoona, Pa., 482,126. Filed Dec. 23, 1891.

A signal between the cab of the engine and the cars of the train employing both electricity and compressed air or steam in its operation.

Electric Alarm Clock, J. McMillan & G. H. Taylor, Philadelphia, Pa., 482,133. Filed Mar. 26, 1891.

Feed Indicator for Boilers, A. Guasco & A. Chusin, Marseilles, France, 482,171. Filed Oct. 8, 1891.

Watchman's Electric Time Recorder, E. R. Heyser, Leon, Mex. 482,251. Filed Mar. 2, 1892.

Electric Annunciator, E. D. Moore, New York, N. Y., 482,263. Filed Feb. 18, 1892.

Electric Railway Signal, C. K. Hall, New Orleans, La., 482,306. Filed April 4, 1892.

A protection signal between individual cars in a train.

Conductors, Conduits and Insulators:—

Conduit System for Electric Railways, R. Lawrence, St. Joseph, Mo., 481,959. Filed Jan. 7, 1890.

A railway conduit having the trolley wire placed at one side in such a manner that the conduit may also be used for a cable system or other purposes.

Electrical Circuit and Cable, J. A. Barrett, Brooklyn, N. Y., 482,149. Filed Jan. 8, 1891.

Employs a single mesh of cord woven between and about two naked conductors.

Electric Conductor, J. A. Barrett, Brooklyn, N. Y., 482,150. Filed Jan. 8, 1891.

Claim 1 follows:

An electric conductor or group of conductors having a covering of paper, cloth or other flexible material provided with tucks extending transversely to the lines of flexture.

Electric Conductor, J. A. Barrett, Brooklyn N. Y., 482,151. Filed July 17, 1891.

Employs a plurality of independent circuits each consisting of a pair of conductors formed into a single oblong strand.

Electric Circuit and Cable, J. A. Barrett, Brooklyn, N. Y., 482,152. Filed Aug. 23, 1891.

Consists of a pair of flat conductors arranged edgewise with relation to each other.

Electrical Conductor, P. H. Holmes, Gardiner, Me., 482,177. Filed Jan. 2, 1892.

Claim 1 follows:

An electric conductor composed of particles of plumbago disposed in strata which lie in planes parallel with the direction of the current.

Means for Drawing Cables into Conduits, T. F. O'Connor, New York. N. Y., & J. W. Marsh, Pittsburgh, Pa.. 482,270. Filed Jan. 8, 1892.

Employs a series of drawing wires connected to the cable at different points along its length.

Electric Insulator, W. H. Clark, Brooklyn N. Y., 482,297. Filed May 21, 1891.

An insulator having a depression in its top for supporting the line wire and side projections for the tie wires.

Electric Cable, J. A. Barrett, Brooklyn, N. Y., 482,328. Filed Aug. 28, 1891.

Employs a core of hollow structure of paper or similar material upon which the conductors are secured at a distance from one another.

Dynamos and Motors:—

Armature for Dynamo-Electric Machines, J. Nebel, Charlton, 482,265. Filed Nov. 11, 1891.

An armature having not less than eight conducting bars, each bar connected not to the opposite bar but to the second, third or tenth before the opposite, and each brush touching two, three or ten commutator segments.

Galvanic and Thermo-Electric Batteries:—

Battery Connector, R. B. Knowles, Brooklyn, N. Y., 482,012. Filed Oct. 15, 1891.

A battery connector, having a screw-threaded projection provided with a shoulder for the purpose of making rigid contacts.

Heating:—

Electric Furnace Generator, E. Berliner, Washington, D. C., 481,999. Filed Aug. 31, 1887.

Employs an electromagnet having an axial bore and an armature acted upon by a heater, provision being made for intermittently passing a cooling fluid through the bore of the magnet against the armature.

Electrical Heater, J. V. Capek, New York, N. Y., 482,074. Filed Mar. 5, 1891.

Claim 4 follows:

The combination with a heating conductor and enclosing box of a cover therefor and a composition containing graphite and a metallic oxide between the conductor and the cover.

Lamps and Appurtenances:—

Ceiling Block for Incandescent Lamps, L. Stieringer, New York, N. Y., 482,104. Filed July 3, 1886.

Provides means for removing the weight of the lamp from the electric connection in the ceiling box.

Support for Electric Lamps, A. Wright, Providence, R. I., 482,112. Filed Mar. 23, 1892.

Electric Arc Lamp, J. T. Birch, Pittsburgh, Pa., 482,157. Filed Apr. 4, 1892.

Employs two hubs, each provided with radially arranged holders for carbon rods, a series of cam projections connected to the shafts carrying the hubs, and reciprocating dogs engaging said projections and rotating the shafts.

Electric Arc Lamp, J. E. Gaston, Sparta, Ill., 482,240. Filed May 31, 1892.

Employs a frame plate for the carbon carrying mechanism, having opposite guiding tracks projecting from opposite sides of the plate and tracks on one side of the frame plate arranged parallel with those on the opposite sides.

Electric Arc Lamp, J. F. Kester, Terre Haute, Ind., 482,253. Filed May 11, 1892.

Employs a clutch mechanism consisting of a friction block gripping the carbon holder and set in the arms of the collar surrounding the carbon holder, the whole being placed within a single armature frame pivoted at one point.

Measurement :—

Meter for Alternating Electric Currents, O. B. Shallenberger, Rochester, 481,975. Filed Oct. 31, 1888.

Employs a closed secondary conductor, consisting of continuous rings connected in parallel.

Induction Coil for Electric Meters, E. Thomson, Lynn, Mass., 482,209. Filed Mar. 5. 1889.

Has for its object to obtain when desired a larger proportionate registry for a small than for a large consumption of current.

Electric Meter, F. Teague, London, England, 482,324. Filed Nov. 17, 1891.

Employs an armature having a central mercury contact and an outer annular mercury trough adjustable to regulate the immersion of the armature.

Miscellaneous:—

Apparatus for Cutting Minerals, L. B. Atkinson and H. W. Ravenshaw, London, and F. Mori, Leeds, England, 481,921. Filed Aug. 18, 1891.

An electric coal cutter, employing an automatic rope feed receiving reciprocating movement from an eccentric rotated by the motor axis.

Apparatus for Electrically Purifying Water, L. T. Stanley, Brooklyn, N. Y., 481,979. Filed Feb. 11, 1890.

Power Transmitting Device, E. D. Weyburn, Chicago, Ill., 481,988. Filed Apr. 16, 1891.

A portable electric motor adapted to be moved along the side of a shop or factory and having power transmitting mechanism adapted to be applied in any portion of the work.

Rheostat, H. W. Lawrence, Denver, Col., 482,093. Filed Apr. 25, 1891.

A rheostat for regulating the brilliancy of incandescent lamps.

Automatic Battery Cut-Off, W. S. Richards, Natick, Mass., 482,136. Filed Jan. 8, 1891.

Employs a bell crank lever loosely engaged with the armature and having a terminal, and so arranged as to momentarily engage another terminal secured to the armature.

Electric Valve Controller, E. F. Roberts, Columbus, Ohio, 482,188. Filed Aug. 26, 1890.

Has for its object to automatically regulate the pressure and temperature in heating systems.

Telltale for Electrolytic Refineries, F. B. Badt, Chicago, Ill., 482,148. Filed May 16, 1892.

Electrical Gas Lighter, J. E. Hamilton, Chicago, Ill., 482,172. Filed March 11, 1892.

Electric Connector for Hose, C. F. Kellom, Delair, N. J., 482,181. Filed Dec. 11, 1891.

Magnetic Separator for Ore Concentrators, C. E. Seymour, Lake Geneva, Wis., 482,323. Filed Oct. 2, 1891.

Railways and Appliances :—

Automatic Trolley Disconnector, G. A. Kimball, Seattle, Wash., 481,956. Filed Nov. 21,1891.

Employs a pivoted trigger and a weight normally hung within a slot formed in the short arm of the trigger.

Trolley and Electric Railways, C. A. Adams and T. J. Thorp, Lincoln, Neb., 482,031. Filed Mar. 25, 1892.

Employs an internally screw-threaded sleeve screwed to the end of the pole and a lock knot bearing against the sleeve.

Trolley for Electric Railways, J. M. C. Tyner and S. S. Irving, Minneapolis, Minn., 482,325. Filed Nov. 30, 1891.

Claim 1 follows:

A trolley carrying a detent adapted to occupy a position over the trolley wire at a point in the rear of the trolley wheel.

Switches and Cut-Outs :—

Electrostatic Switch and Phase Indicator, A. U. Alcock, Melbourne, Victoria, 482,082. Filed May 26, 1891.

Claim 5 follows:

An electrostatic switch, consisting of the combination of a circuit closer, relatively movable plates of a condenser controlling said circuit closer and an indicating device controlled by said plate or plates.

Telegraph :—

Printing or Recording Telegraph, Z. T. Lillard and U. Erhard, Kansas City, Mo., 482,015. Filed Jan. 23, 1892.

A writing telegraph, in which each character of one instrument shall be in direct electrical connection with the like character of other instruments.

Combined Telegraph Key and Sounder, D. J. Ludwig, New York, N. Y., 482,129. Filed May 2, 1892

Employs a bifurcated frame and armature lever playing between the sides and the sounder magnet supported above the armature lever.

Electrically Adjusting Relay, W. S. Richards, Natick, Mass, 482,137. Filed Sept. 14, 1891.

Provides means whereby the tension of the spring is automatically adjusted by the strength of the current.

Telephones and Apparatus :—

Telephone Exchange Apparatus, A. S. Hibbard, New York, N. Y., 482,174. Filed June 2, 1892.

Employs a repeating coil, having one of its windings connected with the order circuit and an independent loop extending from the terminals of the receiving telephone and formed into a closed circuit with the other winding of the repeating coil.

ENTERPRISE ELECTRIC CO.

MR. W. C. MCKINLOCK, president and treasurer of the company, has just returned to Chicago from New York and pleasure resorts of the East. He also spent a short time in Bristol, R. I., on a business tour to the National India Rubber Company's factory, for which company the Enterprise Electric Co. has recently been appointed general Western agents.

Mr. W. F. Richardson, manager, has left for St. Louis to look after the business of the company at that place through the new branch house established lately there at No. 15 North 9th street.

The fall rush is fairly on, and the company have reason to be much encouraged thereby. The N-I-R-wire is popularizing itself because it is seamless, and by being manufactured of the purest and best of materials. The outlook is very flattering.

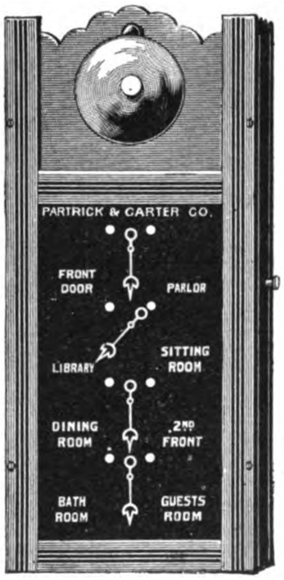
TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

Electricity will stand at least as much advertising as Soap, and make a larger return on the investment.

PARTRICK & CARTER'S NEW "SET-BACK" ANNUNCIATOR.

PARTRICK & CARTER Co., of Philadelphia, have just introduced to the notice of the trade a new automatic set-back annunciator, which bids fair to become very popular, and which the makers expect to supersede the old style trip annunciators in ordinary use. It is a well-recognized fact, they say, that the ordinary house annunciator does not fully answer the purpose for which it is designed. Servants and others will not trip or restore the drops, needles or other indicating mechanism, and hardly ever know from which room or locality the call proceeds, as there are sometimes from two to four pointers or drops registering on the dial. In this automatic system only one, and that the last call, remains pointing or indicating. Each new call resets the pointer that indicated the previous call, no attention to the annunciator other than observing the dial when the call comes in being required. The appearance of the automatic is the same as that of the "King" (one needle giving two indications) except that the resetting knob is dispensed with. All those who have had any practical experience with the ordinary annunciators which have to be tripped every time a call comes in, can appreciate this great improvement in the annunciator line, with its absolute certainty of receiving the last call only, and its freedom from complexity or liability to get out of order. This new annunciator is furnished from stock in all the leading varieties of wood cabinet. It is well made, like all the products of this house, and is very moderate in price.



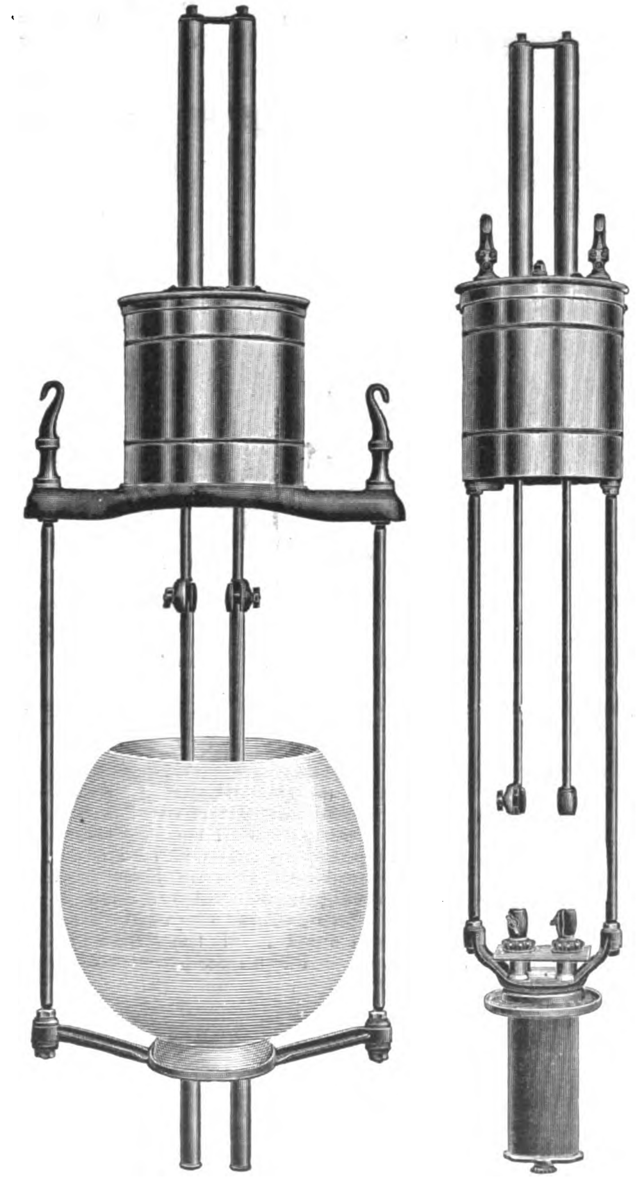
PARTRICK & CARTER'S NEW AUTOMATIC SET BACK ANNUNCIATOR.

THE D. & D. ELECTRIC MANUFACTURING COMPANY OF MINNEAPOLIS.

A NEAT and interesting catalogue of the dynamos and motors has been issued by the D. & D. Electric Manufacturing Company of 745-747 Washington avenue north, Minneapolis, Minn. The company are now making constant potential motors, incandescent dynamos, and power generators. Their type of machine is illustrated and described in this issue of THE ELECTRICAL ENGINEER. Besides giving a number of technical details as to their apparatus the company add the testimonials of a great many concerns that have had their dynamos and motors in use on all classes of work; and the reports are uniformly most favorable. Mr. Gilbert Donaldson is president and general manager of the company and Mr. Otis Humphrey is secretary and superintendent.

THE MONITOR DOUBLE ARC LAMPS OF THE WESTERN ELECTRIC CO.

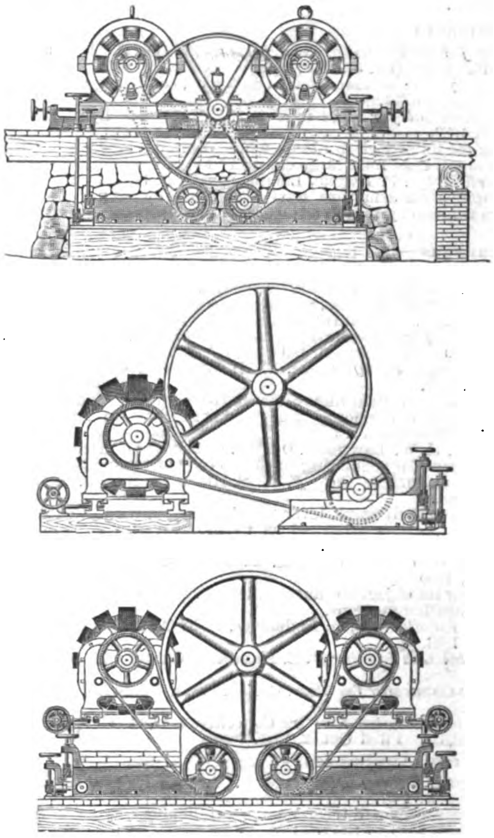
A HANDSOME new catalogue in stiff cloth boards has been issued by the Western Electric Co., of Chicago, New York, etc., devoted to its well-known and widely used arc lighting system. Illustrations and descriptions are given of the dynamos, lamps, switches, etc., and the pamphlet also includes some new apparatus which, while it has been successfully introduced, has not before been brought prominently to notice. Among these important novelties may be mentioned the "Monitor" double carbon arc lamp, which is here illustrated in Figs. 1 and 2, showing the wide frame style, and the narrow. These "Monitor" lamps are equipped with two independent regulating mechanisms, each of which controls the burning of a distinct pair of carbons. A simple automatic switching device serves to bring the second lamp mechanism into circuit and operation when the first mechanism has consumed its carbons. These lamps are usually supplied with half-inch carbons 12 inches long, but can easily be equipped to take carbons five-eighths inches in diameter, 14 inches long. They will burn two nights, or thirty hours, without retrimming. An interesting and valuable feature of economy with these lamps is that the adjustment of each lamp mechanism can be made without regard to its fellow; and it is claimed that proper adjustment is also much more easily secured than where the two feeding rods are regulated by one and the same mechanism. Another advantage claimed lies in the fact that in these double lamps no energy is wasted in holding up an idle but heavy carbon rod for several hours.



FIGS. 1 AND 2.—THE WESTERN ELECTRIC "MONITOR" DOUBLE CARBON LAMPS.

MODIFICATIONS OF THE EVANS FRICTION SYSTEM OF DRIVING DYNAMOS.

OUR readers are familiar with the Evans friction cone system, several times illustrated in these columns, of driving dynamos.



FIGS. 1, 2 AND 3.—APPLICATION OF EVANS' FRICTION CONE SYSTEM TO DYNAMO DRIVING.

We herewith illustrate a new method of application introduced by the Evans Friction Cone Co. of 85 Water street, Boston. The cuts, Figs. 1, 2 and 3, are so simple and plain that little explanation is needed. By this means, for example, 150 h. p. can be transmitted by the aid of an auxiliary pulley; two dynamos can be driven by one pulley; and one or both can be started and stopped while the driving pulley is running.

CLAYTON AIR COMPRESSOR WORKS.

WE have received from the Clayton Air Compressor Works, of 43 Dey street, New York, a copy of their handsome new catalogue No. 7, just issued. It is a large quarto of nearly 100 pages. It is the most complete one of its kind ever issued, and describes in detail the various styles of steam and belt-actuated air compressors for use in mining, tunneling, railway and bridge building, pumping natural gas, supplying pneumatic tubes, operating pneumatic riveters, tools and cranes, aerating water, elevating water, acids and other liquids, submarine work, operating oil fuel burners, refrigerating and ventilating, charging automatic sprinkler systems, stripping rubber hose in rubber factories, testing tinware, agitating liquids of all kinds, finishing silk ribbon, exhausting incandescent lamps, etc. It also illustrates and describes the new Clayton high pressure compressor, suitable for air or carbonic acid gas. The field of usefulness for compressed air is constantly broadening, and this catalogue shows several new designs representing the latest and most enlightened features of air compressor practice. It also contains testimonials, information and data of interest to users of compressed air, illustrations, tables and price lists, not only of the Clayton air compressors, but of the Clayton steam and belt-actuated vacuum pumps, of the Clayton fly-wheel steam pump, especially suitable for pumping coal tar, and also of air receivers, boilers, rock drills, smiths' tools, hose, couplings, etc. Copies of this catalogue, estimates and general information will be gladly furnished upon application.

THE NOVELTY ELECTRIC CO. of Philadelphia, have the contract for doing all the construction work on the new Masonic Temple at Camden, N. J.

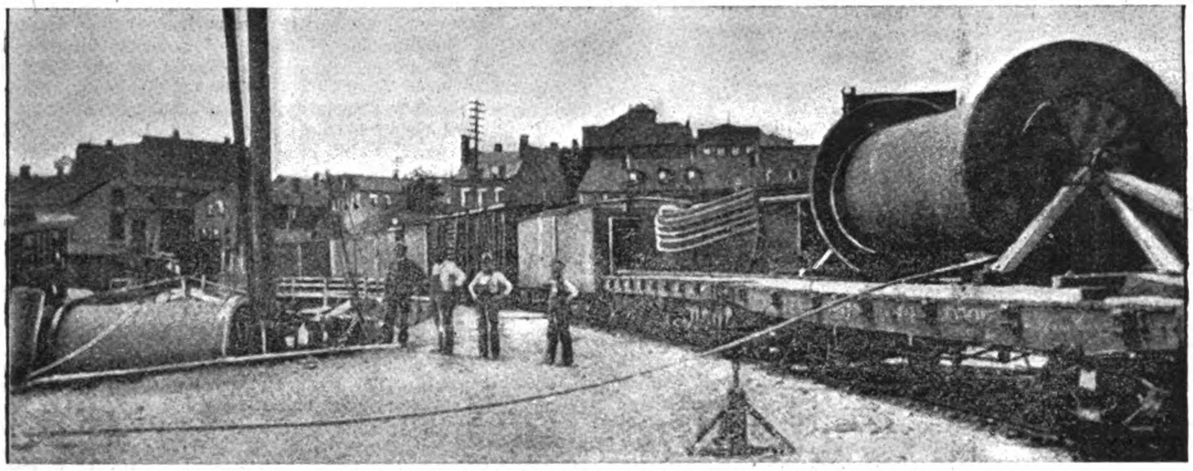
A THREE AND ONE-HALF MILE OKONITE CABLE FOR TELEPHONE WORK.

The submarine cables manufactured by the Okonite Company (Limited), 13 Park Row, New York, and so extensively used in the exacting applications of the leading telephone and telegraph corporations in the United States, are recognized as possessing exceptional merit for pliability, durability and efficiency. These results, so satisfactory to both the manufacturer and the purchaser, are due in part to the insulating properties of "Okonite," and in part to the extreme care exercised in the selection of all material, together with the close attention given during every stage of the manufacture of the cable, from the time it enters the factory at Passaic, N. J., as raw material, to the time it is shipped to its final destination as a finished production.

The Southern New England Telephone and Telegraph Company recently accomplished the laying of an "Okonite" submarine cable from a point on Pine Island near New London, Conn., across Long Island Sound to Fishers Island. This cable was three and one-half miles long, contained six copper conductors, weighed 50,000 lbs. and was in one length, without splice. It was transported from the factory at Passaic, N. J., on a "flat" car, on which was constructed a special reel, and laid from point to point without delay, accident or call for special help.

The entire management of transferring from the car, laying, etc., from start to finish was under the direction of Mr. E. B. Baker, superintendent Southern New England Telephone and Telegraph Co, ably assisted by Mr. R. D. Blish, the cable expert of the telephone company.

Our illustration, taken from a photograph, shows the cable after it arrived at New London, as it is being transferred from the reel on the "flat" car to the reel on the float, from which it was laid.



Unreeling Okonite Cable Crossing Long Island Sound to Fisher's Island.

The Southern New England Company, we are informed, has also laid a new length of cable between Pine Island and Eastern Point (on the mainland), thus insuring to the public a continuation of the prompt and reliable telephone service which they so zealously maintain.

THE PATTON MOTOR AND MANUFACTURING CO.

The above-named company have just completed a very handsome electric car of the well-known Patton system for Louisville, Ky., to be followed by nine more of the same style. The generating dynamo on the car takes the place of the fly wheel of the gas engine, being coupled directly on the shaft. The machine runs at a speed of twenty miles per hour, and under test pulled a freight train of eleven cars. One hundred cells of storage battery are used on this car, the standard number, however, which will be used in future being fifty, they simply being an adjunct to this system and not called upon to withstand the strains of a straight storage car. These batteries have been specially designed for great durability, combined with reasonable efficiency. The advantages of this system are that the generating plant is always furnishing the power for driving the car except under abnormal conditions of load, when the batteries assist, and the initial cost of the system is moderate.

The tests to which the Patton motor cars have been subjected have shown them, it is claimed, to be reliable and economical.

APPRECIATION IN THE SOUTH.

A reader in the South writes us: "I have noticed the growth of The Electrical Engineer with pleasure, and await its coming each week with considerable anticipation. I regard it as *the* paper for the profession. I wouldn't miss it for worlds."

NEW ENGLAND NOTES.

Jewell Belting Company, Hartford, Conn. The following is a partial list of the recent orders which this company has received for use on electric work: Jamestown Electric Street Railway Company, Jamestown, N. Y., two 36-inch double belts; Richmond Railway and Electric Company, Richmond, Va., one 56-inch double, one 36-inch double belts; Hartford Electric Light and Power Company, Hartford, Conn., one 60-inch 3-ply, one 44-inch double belts; Jersey City and Bergen Railroad Company, Jersey City, N J., three 27-inch double belts; North New York Electric Light Company, New York City, two 48-inch double belts; Chicago, Milwaukee and St. Paul Railroad Company, Milwaukee, Wis., one 56-inch double belt; Albany Railway Company, Albany, N. Y., one 48-inch double belt; Elizabeth Electric Light Company, Elizabeth, N. J., one 42-inch double belt; United Electric Company, Springfield, Mass, one 44-inch double belt. A recent visit to their factory in Hartford, showed every department full at work, and large electrical belts in every stage of construction. The Jewell belt has undoubtedly met with much favor amongst electrical men, and it is giving great satisfaction wherever used as evidenced by the large number of repeat orders which they receive. It is a distinct advantage to own one's tannery outright, as a much more careful selection of leather can be secured, and the company is well aware at all times of just what class of hides the leather is being produced from.

The Holyoke Machine Company, of Worcester, Mass., are furnishing the shafting, clutches and complete power transmission machinery for the following plants: Stamford Electric Light and Power Co., Stamford. Conn.: Mott Haven Electric Light Company, Mott Haven, N. Y.; Hudson Electric Light and Power Company, Hoboken, N. J.; Macon Electric Light Company, Macon, Ga., and the Suburban Electric Company, Elizabeth, N. J. They have also recently installed a number of their well-known Hercules turbines for electric work, which are giving excellent satisfaction, and are paying special attention to the governing properties of these wheels for electric railway work.

The Beacon Vacuum Pump and Electrical Company, Boston.—A syndicate of New York capitalists representing $5,000,000 are completing arrangements with this company, whereby they will have the right to establish lamp factories in England, Germany, France and Austria, in which the Beacon vacuum pump will be used, and the Beacon incandescent lamp manufactured. This lamp has attracted world-wide attention, and electricians are, it would seem, rapidly becoming convinced that exhaustion by metallic pumps is not only practicable but beneficial.

PHILADELPHIA NOTES.

Partrick & Carter Co.—The patrons of the Partrick & Carter Co. will soon be favored with the presence of the well-known salesman Mr. T. L. Townsend. who started last Wednesday on a tour covering nearly every State in the Union and a part of Canada; and is prepared to present many new novelties in electric bell supplies.

Francis, Nardi, Strang & Co., agents for the Merchantville (N. J.) Electric Light Co., are extending their plant through Dudley and Cramer Hill to Wrightsville, and from Cramer Hill to Pavonia. The above firm will open a store at Cramer Hill, where they will keep a full line of electrical supplies.

Mr. Charles E. White has the contract for installing a 50-arc light plant in the store of W. H. Wanamaker & Co., Twelfth and Market streets. The plant will be the American system, and a 60 h. p. Armington & Sims engine will be required to operate it.

KERITE IN THE ST. CLAIR TUNNEL.

The St. Clair Tunnel, near Detroit, owing to the dampness and gas, enabled the Great Western Telegraph Co. to fully test the claims made by Day's "Kerite" as to its being gas and damp proof. Their cables are exclusively used at the openings of the tunnel, and recent advices report perfect insulation.

RIES ELECTRIC SPECIELTY CO.

One would be surprised to see the enormous amount of shipments being made by the Ries Electric Specialty Co., of Baltimore, Md. Their regulating sockets are daily becoming more in demand, and large orders are being received from almost every portion of America and the Old World where the alternating current is used. This company are shortly going to increase their plant again so as to meet the rapidly growing demand for their specialties.

THE FALL CAMPAIGN.

Handsome steel engraved portraits of President Harrison and Mr. Cleveland are being sent out by Alexander, Barney & Chapin. They have gotten out a three-page folder, which, besides the portraits, gives the figures of the popular vote for President from 1824 to 1888, also a table of the electoral vote of each State at the present time, with blank columns headed "Cleveland" and "Harrison," so that political enthusiasts may have a choice to set down their prognostications for the coming election. Between the candidates is the "A. B. C." lamp, which shines for all.

NOTES FROM PEORIA, ILL.

The Fort Clark Street Railway Co. have just finished putting in a new engine and dynamo. The engine is a "Ball" of 180 h. p. This gives them a reserve of power, there being two other "Ideal" engines of 125 h. p. connected to two M. P. dynamos of Thomson-Houston manufacture.

The Rapid Transit Co. are progressing rapidly on their new line. The track is nearly finished and the poles are set. The trolley wire is not strung yet but soon will be. They will get their power from the Central R. R. plant.

Nicol Burr & Co., founders and general machinists, are putting in a 150-light generator to light their shops, etc. This is necessary as they intend to run nights to keep up with their orders.

The Local Edison Co.—There is considerable comment here on the delay of the city council in granting the Edison Co. a franchise for lighting and power. Also the Central Company, a company composed and backed by Peoria parties. The council wants to give a ten-year franchise, but the two companies won't accept one for less than twenty years. The Jenney Co. here are the only ones in the city. This company is controlled by the Gas Co., who have a monopoly and do not furnish all the lights that are ordered. It is almost an impossibility to get any incandescent lights at all.

NEW YORK NOTES.

Mr. C. J. Field, of the Field Engineering Co., is busily engaged in Philadelphia, putting in the first section of trolley road for the Philadelphia Traction Co. During a trip to this city last week he reported that rapid progress is being made. The Westinghouse Co. secured the first slice of the contract for motors, etc., and expect to secure all the rest on the same terms, as provided in the contract. The first power plant, to be put in by Mr. Field, will be of a temporary nature, as the Traction Company hopes in a year or two to have a magnificent power house, and probably more than one. Philadelphia—or at least one part of it—will soon be enjoying the blessings of the trolley system.

W. R. Fleming & Co., Mail & Express Building, this city, have just completed a plant for Hotel St. Lorenz in this city, that consists of two 60 h. p. Ideal engines, and are also installing in the Century Club, in this city, one 50 and one 60 h. p. Ideal engines. They have also recently taken several contracts for complete steam plants and are now erecting the following: Hotchkiss School Association, Lakeville, Conn., one complete plant of 70 h. p. Ideal engine and 90 h. p.. horizontal tubular boiler. Mount Vernon Construction Co., Alexandria, Va., complete boiler plant of 300 h. p. Municipal Electric Light Station, South Norwalk, Conn., complete plant of 100 h. p. Ideal engine and 125 h. p. horizontal tubular boiler.

Mr. I. P. Frink, of 551 Pearl street, New York, manufacturer of the well-known "Frink" reflectors, has recently made installations in the following churches: M. E. Church (South), Marshall, Mo.; Presbyterian Church, Washington, Ia.; First Congregational Church, Bay Shore, L. I.; M. E. Church, Stroudsburg, Pa.; Presbyterian Church, E. Stroudsburg, Pa.

The Electrical Engineering and Supply Co., of Syracuse N. Y., have issued a descriptive catalogue of 137 pages, profusely illustrated, and covering more than 450 different devices relating to electric lighting, railway and construction work. The book also contains a useful wiring table for 16 c. p. incandescent lamps of 50 and 110 volts.

The United States Projectile Co., of Brooklyn, N. Y., are so driven with work that they have placed the order with the Berlin Iron Bridge Co., of East Berlin, Conn., for an addition 240 feet long to their present building. The addition will be entirely of iron from the designs of the Berlin Company.

PHILADELPHIA NOTES.

Warren Webster & Co., 491 North Third street, Philadelphia, have issued a very neat, handsome and convincing pamphlet on the Williames vacuum system of steam heating which they control, and which they have been remarkably successful in introducing. It describes and illustrates the system and prints a number of testimonials which go to prove how valuable an adjunct the system is in the steam heating of any building, group of buildings, train of cars, etc. The pamphlet also contains information as to the patent litigation decided in favor of Warren Webster & Co.

Mr. Jno. A. Blattau, special traveler of the Ries Electric Specialty Co., of Baltimore, Md., says that the Ries regulating socket is making thousands of new consumers for the central stations, and that enterprising construction firms are reaping a harvest, particularly in wiring residences with this device.

WESTERN NOTES.

The Central Electric Company have taken the agency for "Machines for Painting Mouldings," recently illustrated in **The Electrical Engineer** and manufactured by the Standard Paint Company of New York City. These machines can be had from the Central Electric Company, or any of its branches; the Southern Electrical Supply Company, at St. Louis, Mo.; Gate City Electric Company at Kansas City, Mo., and the Western Electrical Supply Company at Omaha, Neb.

A Large Contract for Arcs.—Col. F. O. Richards, of the Standard Electric Company, of Chicago, has just closed contracts with the Cincinnati Edison Electric Company for fifty 50-light Standard dynamos for running 2,500 arc lamps of 2,000 c. p. each for street lighting. In addition to this they have already furnished two 50-light machines for commercial lighting. This is one of the largest contracts ever closed for arc lighting apparatus.

Decatur, Ill.—The Piatt Electric Co., 142 South Water Street, has bought the whole lighting business, etc., of R. F. Piatt, as well as the stock and business of the Decatur Manufacturing Co., electrical contractors, etc. Until further notice the business of the Piatt Electric Co. will be carried on by Mr. E. E. Gibson, secretary and treasurer, who has also been appointed purchasing agent.

The Electric Appliance Company are enjoying great activity in all lines of their rapidly increasing business.

Their pioneer efforts in the introduction of the Elkhart transformer are beginning to bear fruit, and they are in constant receipt of "second orders," which testify to the satisfaction which the "Elkhart" is giving.

George Cutter, 333 The Rookery, Chicago, has got out a very handsome little design for back of small postal card, telling about the improved Schaefer incandescent lamp. It is only another of Mr. Cutter's clever little advertising schemes, and, like the rest of them, is right "up to date."

T. A. Pamprin, president of the Electric Manufacturing Co., of Oconto, Wis., manufacturers of the "Brilliant" incandescent lamp, spent several days in Chicago during last week.

T. C. Rafferty, secretary of the Great Western Electric Supply Co., Chicago, left this week on a flying business trip through Texas and Louisiana.

Mr. S. J. Bear, of Topeka, Kan., has been elected supreme chancellor of the telegrapher's organization, at the recent Kansas City meeting.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

VOL. XIV. SEPTEMBER 28, 1892. No. 230.

THE GENESIS OF THE MODERN DYNAMO: ANTONIO PACINOTTI.—II.

BY

Franklin Leonard Pope

MORE than twenty-five years after his original work Dr. Pacinotti presented a detailed statement concerning the history of his discoveries to the jury of the International Electrical Exposition at Turin, in 1884. This statement is a document of surpassing interest, and conclusively establishes the claim of its author to the credit of the invention of the modern system of armature winding and commutation, if not to the further honor of a discovery which so eminent an authority as the late Clerk-Maxwell once asserted, and justly so, to be the most important one that had been made in twenty-five years—the reversibility of the dynamo machine. The paper bears date September 24, 1884.

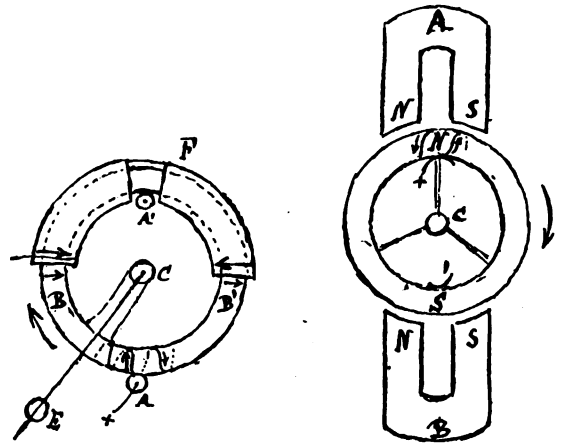
The earliest conception in the mind of Dr. Pacinotti of the ideas which afterwards led in logical sequence to the construction of the machine on which his title as a discoverer rests, appears to be contained in a manuscript notebook which has been preserved by him, in which, under the date of 1858, is found the following entry:

> Perhaps the use in magnetic machines of the induced current in lieu of currents obtained directly from the battery might be found useful.

This passage embodies a distinct conception of the idea of the reversibility of the magneto-electric machine; but the further conception of the closed armature winding, or, as Pacinotti usually terms it, the "transverse connection" follows almost immediately in another entry in the same book, in which is clearly outlined the suggestion of making use, in an apparatus for measuring electrical currents, of an annular helix composed of a single layer of wire with transverse connections (Fig. 6). The following is a translation of this memorandum:

> The instrument consists of a light ring B B' wound helically with a copper wire whose turns might be insulated as in the rheostat, without the wire being covered with silk.[1] The two ends of the wire are soldered together and the helix is closed. This circular helix is placed in a vertical plane, is centered at C, and counter-weighted so that its equilibrium may be indifferent. The helix described is surrounded by another stationary helix, F, which forms a semicircle. The circular helix rests upon two brass rollers A A^1, one of which A is at the middle of the stationary helix, the other being at the extremity of the diametrical line. The current goes through the stationary helix, thence passes through the movable circular helix by means of the brass rollers A A'. Supposing that A be in connection with the positive pole, A' with the negative, the current divides into two portions at the point A, and as is readily understood, the portion that goes through the part B goes from the circumference to the centre on the front side of the helix, while that which goes through the part B' goes from the centre to the circumference. Supposing the current to go through the stationary helix as indicated by the arrows, the half B of the movable circular helix is attracted, while the half B' is repelled, which compels the movable helix to rotate in the direction indicated by the arrow.
>
> A pendulum E is raised by the motion; this is prolonged in such way as to prevent the deviation from exceeding a right angle; the force of the current is proportional to the sine of the angle of rotation. * * * * The induction current, which during the motion is generated in the contrary direction to the current that produces it, does not exist any more when the motion ceases and does not therefore affect the readings.

It does not appear, however, that Pacinotti ever attempted to reduce this apparatus to practice in the form above suggested, doubtless for the reason that the conception of applying the same principle of construction to the armature of an electromagnetic motor, or, as he calls it, a "magnetic machine," appears to have struck his mind almost immediately, for on the very next page of the same note-book the matter is set forth explicitly in the following sketch and description. (See Fig. 7.)



FIGS. 6 AND 7.

> *Electromagnetic machine without interruption of circuit.*
>
> The wheel C has a ring of iron on which is wound a helix whose turns are insulated as on the wooden cylinder of the rheostat. At N and S are the rollers or springs which touch the successive coils of the helix; from what we have previously said the ring of soft iron will be magnetized transversely; let us suppose the current to be directed in such a way that the north pole is at N, and the south pole at S; if two horseshoe magnets A, B are placed in proximity, as indicated in the figure, the wheel ought to turn in the direction indicated by the arrow. It is easy to see from the arrangement that the induced currents will be able to set a limit to the speed of the wheel but will not be able to produce sparks.

In the last sentence will be noted an expression which goes to show that the author was not unfamiliar with the reaction which we now call "counter-electromotive force."

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[1] The reader is reminded that the term rheostat was then applied exclusively to the now obsolete form consisting of two cylinders, one of wood, the other of metal, geared together so as to wind or unwind from the wooden cylinder a bare wire, the space between the turns being depended on for insulation.—[TRANSLATOR.]

In his written notes, Pacinotti goes on to set forth a method of applying a plurality of layers of conducting wire to the ring armature. This, though afterwards superseded by more practical designs, deserves mention as illustrative of the gradual evolution of ideas in the mind of the young inventor:

> *Construction of the closed helices; continuous induced currents.* * * *
>
> In the circular magnet electromagnetic machine there is developed an induction current contrary in direction to that of the battery. If the current of the battery is no longer sent through the ring, but the latter is turned by power in front of two permanent or temporary magnets, there will be a current induced continually, directed in the same direction. One could consequently make use of such an apparatus for obtaining an induction current directed always in the same direction, just as one might make use of devices adapted to show the rotation of a finite current produced by a circular current.[2]
>
> In constructing the circular helix which is necessary in the electromagnet machine as also in the induction apparatus,[3] I would propose the following plan for enabling more helices to be put on:
>
> Taking the ring, either of iron or of other substance, there will be wound over it a rather thin well-insulated copper wire in case it is desired to make the apparatus for producing the induction current, and a very thin copper strip in case it is desired to construct an electromagnetic machine. At every three or four turns there should be left a loop of the wire or the strip, and after going entirely around the ring the two ends should be soldered together. On top of this first spiral, there can be put another, perfectly similar, but wound in the contrary direction, then another in the same direction as the first, etc. Let us suppose that there are two helices; on the ring we will place a circle of some isolating substance and in this at one portion we will imbed a number of small metal pieces[4] each one of which may connect with the corresponding end of the first helix; on the other portion those that connect with the second, (see Fig. 8). If at the end A we put one end of the first helix in connection with one pole and that of the second helix in connection with the other pole, and at the opposite side B the ends of the two helices are connected together, the current goes through both halves of the ring in the same direction in the two helices, as is necessary.

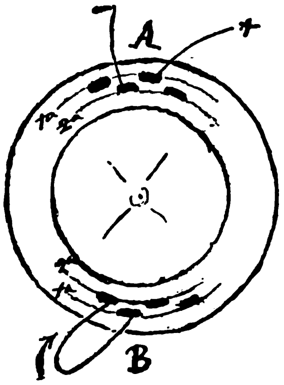

FIG. 8.

Following up the ideas which had suggested themselves to his mind, as shown by the extracts which have been quoted from the note-book of 1858, Pacinotti entered upon a systematic course of experimentation. Providing himself with a ring of round bar iron, he wrapped it for better insulation with a coating of silk, and then wound upon it an endless helix of copper wire of moderate thickness which he insulated with silk and varnish. This helix constituted but a single layer of wire, and its ends were soldered together. A disc of wood was tightly fitted into the interior of the ring after having been thus wound, and the whole was mounted upon a rotatable axis, which was made to pass through its centre. Two contact springs of brass were mounted upon fixed supports, so as to bear respectively against diametrically opposite points on the external periphery of the ring coil. The insulating coating was then removed from each turn of the helix, at the point where, in passing, it would touch one or the other of the two contact springs. The contact springs themselves were connected with the opposite terminals of a galvanometer. Two permanently magnetic steel bars were also provided, which could be supported in various positions with reference to the ring, in such manner that their poles would be in close proximity to its periphery during its rotation.

Under date of January 10, 1859, the following entries appeared in the note-book, referring to experiments made with this apparatus:

> A north pole placed at one extremity of the diameter normal to that which joins the springs, gives a strong deflection when the wheel is turned. After a little time, the needle oscillated very near to 30 degrees; on reversing the direction of the rotation, the direction of the current was also reversed.
>
> On placing another north pole at the other extremity of this normal diameter, the needle oscillated near zero. On placing a south pole instead, at that extremity, the needle resumed oscillating near 30 degrees. The direction of the deflection was the same as with the single north pole; and it was reversed with the direction of rotation.

After making some preliminary experiments with the ring described above, Pacinotti commenced the construction of a somewhat larger one, covered in the same manner with a silk wrapping, and then closely wound with a helix of silk insulated copper wire. Loops were left for forming the connections in the manner referred to in the note quoted above. Only one such helix, however, was made, for the idea had now occurred to the experimenter that the ring might with greater advantage be wound with a number of equidistant consecutive helices, each having a plurality of layers, and that these helices might be connected with each other, and with the corresponding contact upon the commutator, by means of intervening loops left during the progress of the winding. A subsequent experiment, made with a second ring wound in this manner, enabled Pacinotti to observe that when the current from a battery was made to pass between two loops of the helix an actual magnetization of the iron ring took place, the points of opposite magnetic polarity being situated directly underneath the respective points of entrance of the opposite electricities into the helix.

Pacinotti had progressed thus far with his experiments, when his work was suddenly interrupted by the call for volunteers in the war for Italian independence. He responded promptly to the summons of his country, and it was while serving in the field during the campaign of 1859, that another conception of no small importance came to his mind. He relates that he was sitting one evening on the ground upon the heights of Goito, when the radial arrangement of the stacked muskets near at hand chanced to catch his eye, and associating themselves with the constant object of his thoughts, the magnetic machine, gave rise to the suggestion that the inductive influence of the stationary field magnets upon the rotating ring might be enhanced by enlarging, or by forming radial projections upon the iron ring or core of the armature in the intervals which had been left between the helices, a conception which, as we have seen, was embodied in the actual machine which he afterwards constructed.

INDUCTO-SCRIPT.

AT the recent meeting of the British Association, the inducto-scripts of the Rev. F. J. Smith, of Glasgow, were shown and explained by the recorder, Mr. Baynes. A coin or engraved metal is placed on a photographic plate and the induction spark passed from the coin to the metal; on developing an image like the breath-figures appears, not, however, if the experiment is made *in vacuo*. Mr. Glazebrook, F. R. S., has tried moistened bromide plates without or with the external current of one cell; he obtained similar, but rather irregular results.

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2. This comparison is obscure. The original text gives no clue to what devices are referred to.—[TRANSLATOR.]

3. Literally "apparatus for induction," the term by which Pacinotti first designated his electric machine when acting as a generator or dynamo.—[TRANSLATOR.]

4. This first set of commutator segments is designated in the diagram by the figures 1^a (*prima*). The second set is designed by the figures 2^a.—[TRANSLATOR.]

THE MOUNT WASHINGTON SEARCH LIGHT.

BY

A. C. Shaw.

THE top of a mountain 6,300 feet above sea level seems at first sight a curious location at which to install an electric search light, and it will be admitted that few men would ever have conceived the idea of making the experiment. To Mr. L. H. Rogers must be attributed the honor of first suggesting that a search light would be an attraction on the top of Mount Washington, and that it could be operated successfully. Mount Washington, as is well known, is the highest mountain in the States east of the Rockies and north of the Carolinas, and belongs to the White Mountain range in New Hampshire. Large numbers of people visit these mountains every summer, and beautiful little towns and large hotels nestle in the surrounding valleys, most of them being situated where a good view of the king of the mountains may be had. Access to the mountains is extremely easy, the Concord and Montreal Railroad from Boston being the most popular route, as the line runs through country abounding in fine scenery, and takes the traveler to the very base of the mountain where the Mount Washington Railroad begins. Besides affording a vast amount of interest and amusement to the mountain summer visitor, the search light, poised at this extreme elevation, is of great scientific interest, and as much has already appeared in the daily press, an illustrated description of the plant will doubtless be found interesting. Results have been achieved which have never before been thought possible, and many new problems in the study of search lights for signaling and other scientific purposes are attracting the attention of the scientific world. Before describing further the effects of the search light in penetrating the darkness of the rarefied atmosphere at the altitude of 6,300 feet, a description of the plant itself will be found interesting, as it is, perhaps, the highest mountain electric plant—other than mining—in the United States, and has to overcome obstacles not met with in lower levels.

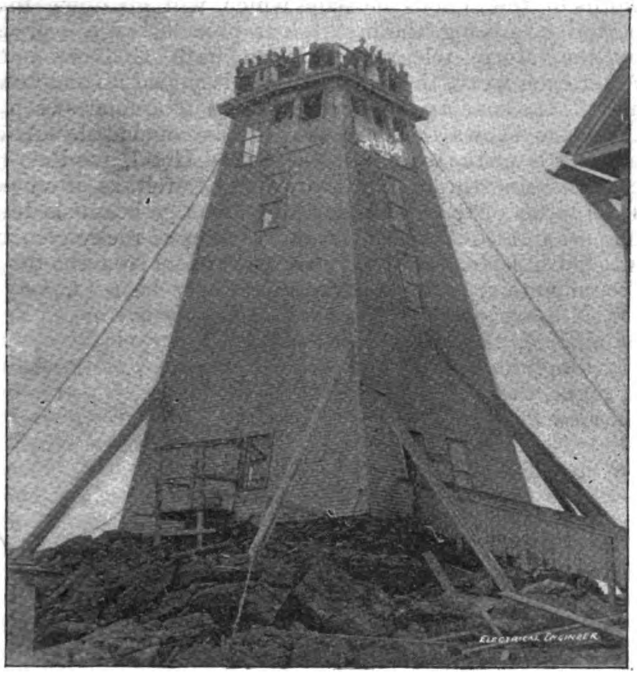


FIG. 1.—TOWER OF THE MOUNT WASHINGTON SEARCH LIGHT.

A tower has been erected on the very highest point of the mountain, a view of which is shown on this page, occupying the site of the old rough open tower used formerly by the Geodetic and Coast Survey. The tower, Fig. 1, is 27 feet square at the base, 50 feet high, and tapers to 14 feet square at the top. It is built of eight 9-inch spruce timbers reaching from the foundation to the top, each of the floors being supported on similar timbers, and the whole tied together by iron straps and bolted, and the frame work chained down to the rocks on the mountain top. The whole building was then covered by heavy planking and clapboarded on the outside, but even with this protection, so severe are the wind and rain storms, the moisture penetrates the building and makes the condition of operating a dynamo extremely severe, the armature after a severe storm being frequently saturated with moisture. The first floor of the tower contains engine, boiler, dynamo and switchboard, the whole steam plant having been furnished by J. A. Grant & Co., of Boston. It consists at present of a 30 h. p. vertical tubular boiler, manufactured by the Erie City Iron Works, of Erie, Pa., which works at a pressure of 80 pounds. The engine will eventually be a 25 h. p. McIntosh & Seymour high-pressure engine, as it is expected that current will be furnished for lighting the Summit Hotel; but at present a 15 h. p. Armington & Sims engine is used. Rainwater is used for the boiler, and it is fed through a National heater by means of a small Worthington pump, which lifts the water from a tank 10 feet below. In dry weather the water is brought up in tanks by one of the Mount Washington Railroad locomotives filled from the watering tanks on the side of the mountain. The dynamo is of the Thomson-Houston spherical armature type, compounded and capable of giving 75 volts and 110 amperes. In spite of the severe conditions owing to the extreme dampness, it has given every satisfaction, and has run without a hitch from the first. The switchboard is of the skeleton type, made of wood, and contains ammeter, voltmeter, a double-pole single-throw 120 ampere switch for the main search light circuit and two 10 ampere switches for the 18 incandescent lights distributed on the different floors of the tower. These lamps are on two circuits, one for the upper floors and one for the engine-room. Fuse blocks and lightning arresters are also mounted on the switchboard so as to prevent any chance of accident. In the engine-room and protruding through the floor may be seen the top of the highest point of the mountain, and the picture, Fig. 2, shows in the centre of the room a red incandescent lamp burning in a vase filled with water, which serves to mark the position of the copper bolt inserted in the

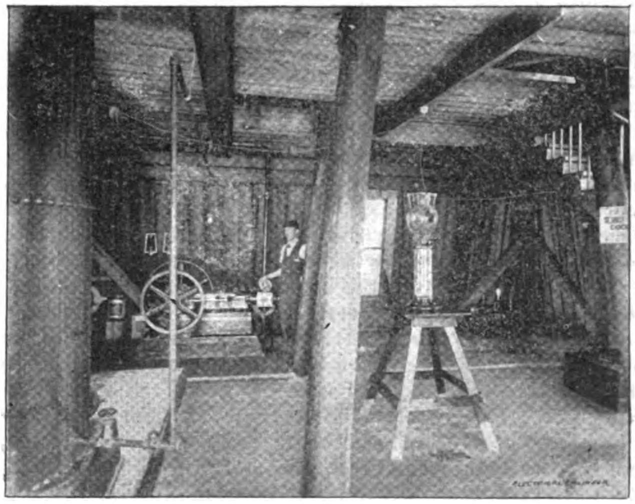


FIG. 2.—DYNAMO ROOM, MOUNT WASHINGTON SEARCH LIGHT.

rock, which formed one of the station marks set by the Geodetic and Coast Survey during their operations, now completed. The second and third floors of the tower are used as storerooms, the fourth as the lower observation-room, and the fifth as the general observation and controlling-room. In this room is the controlling stand shown in Fig. 3, on which is mounted a standard Weston voltmeter and ammeter, resistance coils and various switches for operating the light and the motor in the base of the search light by which the projector can be turned round in any direction, and the elevation altered at will. On the roof of the tower, open to the atmosphere, is situated the search light, Fig. 4, which was manufactured by the General Electric Co. The light is enclosed in a projector of 30 inches diameter, the largest ever made in America, and is of 100,000 c. p., nom., the actual candle power of the lamp without the reflector being 20,000. Hardtmuth carbons, made specially for this work in Vienna, Austria, are used in the lamp, measuring 1¼ inches diameter for the positive, and 1 inch for the negative, the positive carbon being cored. The reflector consists of a Mangin lens with 14 $\frac{15}{16}$ inch focal point made in Paris by a secret process, by which the quicksilver on the back of the reflector can withstand the extreme heat of the arc. The lamp when operating requires 45 volts and about 90 amperes, the voltage of the dynamo being reduced by resistances on the floor below. A full description of the details of the lamp may be found in the ENGINEER of Aug. 24 in Mr. Knowles's excellent article on "The Modern Electric Search Light," so that it is not necessary in this article to describe the lamp in detail, but rather to point out a few of the interesting results.

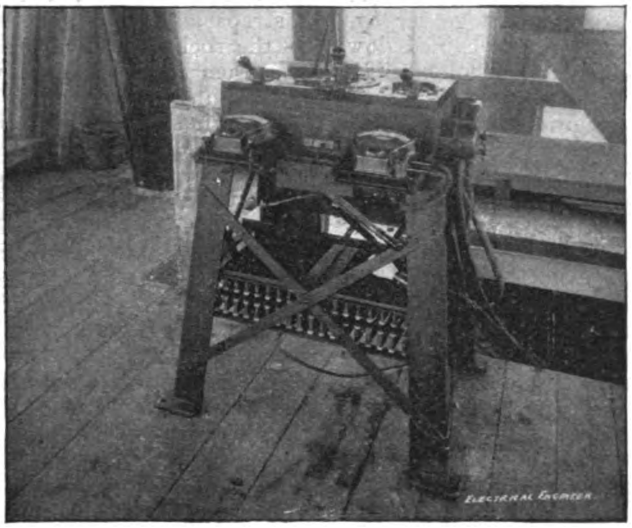


FIG. 3.—CONTROLLING STAND FOR THE SEARCH LIGHT.

Viewed from any of the well-known summer resorts in the vicinity the effect is very fine, and it is astonishing to note the interest shown in the light by the visitors to these hotels, who gather in knots on the verandas and discuss the all-absorbing topic of "search lights" and endeavor to read the messages signaled to them, by means of a code which has been distributed in thousands all over that section of the country. At Maplewood, for instance, where the writer recently stood on one beautiful clear night 20 miles from the top of the mountain by air line, the light was "turned on" the hotel for about 20 minutes, and signals were read with the greatest ease and precision. At that distance the light is almost too bright to be looked at comfortably, and the effect of the illumination on the hotel is quite marked. The time on a watch is easily told and type as large as the heading of this article read with ease. On white surfaces such as the front of the hotel a curious shimmering effect is produced, and small dark patches seem to float constantly over the surface, produced perhaps by the magnified effect of minute particles of vapor in the atmosphere, or by some other phenomenon not yet accounted for. The signaling is accomplished by a metal damper in the inside of the projector which can be lowered between the arc and the lens by a lever extending to the outside, and by means of which flashes of short or long duration can be effected. At Maplewood, on the night when the writer was present, several signals were given and readily interpreted. Before spelling out the words, ten short flashes were given to attract attention; and then came a series of long and short flashes, spelling out the words of the famous message which will go down to all posterity as being the first telegraphic message ever sent by the Morse telegraph: "What hath God wrought." After each word, the beam of light is moved up and down, and at the conclusion of the sentence a circular sweep of the beam shows that the message is concluded. A few minutes later the words: "Maplewood Hotel, good night," came flashing through the air, and one felt as if on personal terms of friendship with the friendly beam shedding its pure light over the intervening miles of rocky glen and wooded hillside. At Fabyan's, eight miles from the top of the mountain, ordinary type can easily be read, and at Mr. Milliken's Glen House, which is only five miles away by air line, the light makes the grounds as light as day. Standing alongside of the projector on the top of the tower at night, the sight is also a very grand one, and a beautiful view of the beam of light can be had. When the projector is turned in the direction of any of the portions of the mountain from one-half to one mile away, the effect is very pretty, as it makes a round circle of light, and shows up any particular object even more distinctly than by daylight. It is a great source of pleasure to the visitors and they never seem to tire of watching the different effects produced. That it is a great attraction in the mountains is amply proven by the fact that in small places where the lights of the village cannot be seen by the naked eye from the mountain top, large bonfires are nightly kindled in the hopes that the ray of light will be turned in their direction. Many letters and telegrams are also received daily with "special requests for the search light," and letters from many emiment men within a radius of 100 miles have

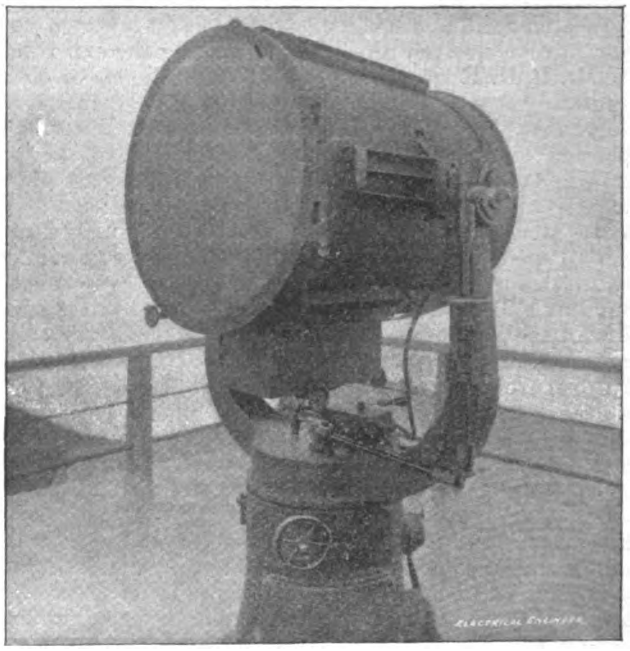


FIG. 4.—THE PROJECTOR ON MOUNT WASHINGTON.

been received stating that the light had been seen and asking for further experiments in their particular directions.

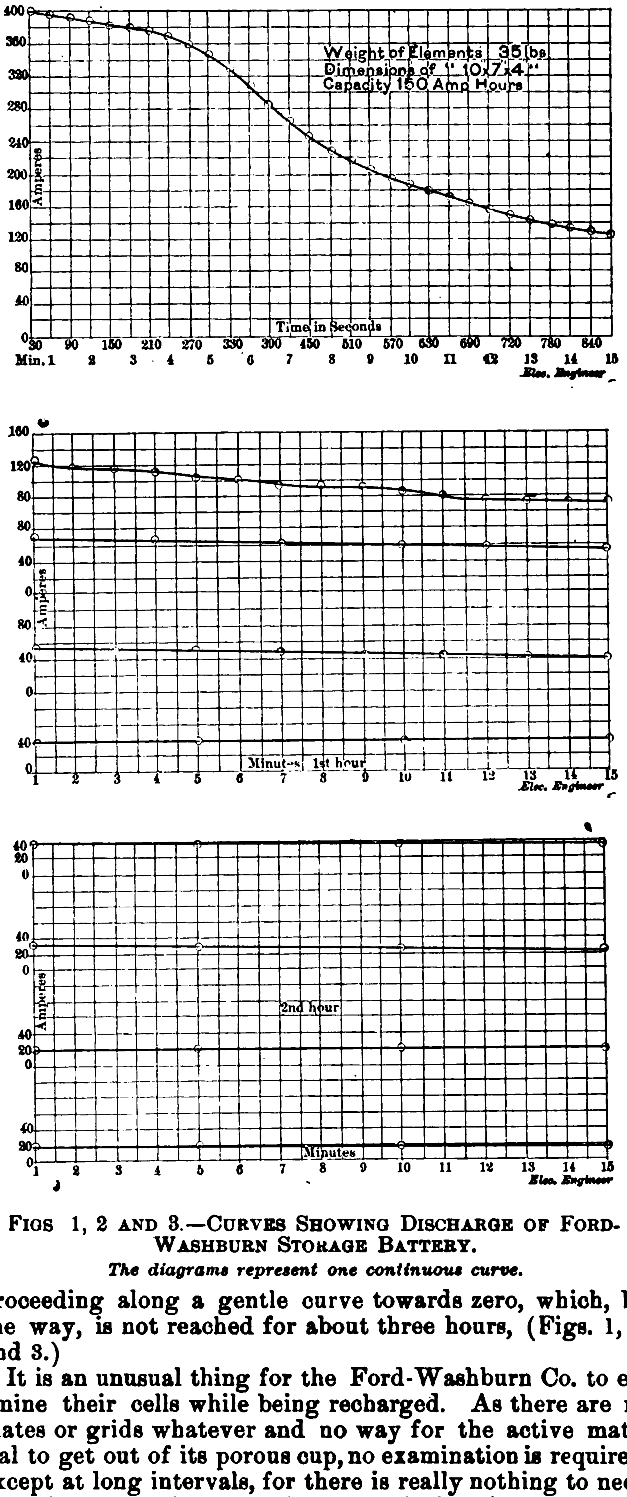
As to the distance from which the light has been seen it is a little difficult to get accurate figures. At Portland, which is 85 miles away, the beam of light has been distinctly seen, and actual telegraphic conversation held with the operator on the mountain, the search light flashing out a message, and the telegraphic operator at Portland repeating it by ordinary telegraph back to the mountain. Many towns 100 miles away have reported seeing it, and one report states that it was seen on one occasion at Pigeon Cove, Cape Ann, on the coast of Massachusetts, a distance of 116 miles. Recently the New England district of the Weather Bureau has instructed Mr. Rogers to make experiments on weather signaling, and for the past three weeks weather signals have been shown at eight o'clock every evening to the surrounding districts, a combination of long and short flashes signifying fine or rainy weather according to the reports from the Bureau. These signals have been seen and read at Exeter, N. H., a town about 100 miles from Mount Washington, and are giving general satisfaction to the surrounding countryside.

It is just about a year since the idea first occurred to Mr. Rogers to put a search light on top of Mount Washington, and great credit is due him for his persistent effort in the face of all adverse criticism and general unbelief in its practicability. The raising of the necessary funds was also a difficulty to overcome, but eventually Mr. Rogers was enabled to raise sufficient subscriptions, to partly pay for the plant, from the railways in the vicinity and from the hotel proprietors, who were slowly led to believe in the value of the search light as a mountain attraction. Mr. T. A. McKinnon, of the Concord and Montreal Railroad, was one of the first to favor the scheme, and rendered all the assistance in his power. Mr. Payson Tucker, of the Maine Central, also added his support to the project, and now nearly all the hotels in the mountains are subscribers. The operating expenses of the plant are all taken care of by Mr. Rogers, who has made a contract with the subscribers to keep the plant in running condition for a period of five years, and expects to refund himself by making a nominal charge of 25 cents admission to the tower.

Mr. Mark Lowd and Mr. Frank C. Sargent are in charge of the plant, and are kept busy showing the interesting features to the numerous visitors, and pointing out the various places of interest from the top of the tower. The light was started on August 13, and will be stopped for the season on October 1, but next season it will be reinstalled at the same place, and from its commanding position amongst the clouds, its piercing rays will without doubt once more light up the mountain tops and penetrate for miles through the surrounding atmosphere to thousands of watchful people in the valleys below, who have come to look upon it as an actual friend and a part of their summer entertainment.

THE FORD-WASHBURN STORAGE BATTERY CAR.

An interesting and impressive test of the storage battery car of the Ford-Washburn Storelectro Co., of Cleveland, Ohio, took place last Thursday in Cleveland. There were on the car a number of gentlemen, capitalists, electricians and others, among whom were Mr. Leopold Wallach, of New York; Chas. W. Kohlsaat, of New York; Messrs. Geo. A. Ford, L. A. Cobb, Geo. A. Washburn and Geo. Hoyt, of Cleveland, and Mr. F. R. Colvin, of The Electrical Engineer. Col. F. K. Hain, General Manager of the Manhattan Elevated Railroad Co., was also to have been present, but telegraphed he would be detained in New York a few days longer and would therefore not be able to inspect the car until the following week. An early start was made with the car over the tracks of the principal street railway companies of Cleveland. There was not a hitch of any kind in the trip. The passengers, after having viewed the beauties of Euclid avenue and compared the behavior of the car with that of its trolley companions before and behind it, proceeded to the works of the company to witness a few simple tests of the battery itself. Those who had not before seen it were surprised at the short-circuiting test in which a cell was connected with heavy copper strips direct to an ammeter of negligible resistance; the instrument showed 400 amperes at the moment of contact, slowly falling to 350 amperes in the course of a few minutes and then gradually and steadily proceeding along a gentle curve towards zero, which, by the way, is not reached for about three hours, (Figs. 1, 2, and 3.)



Figs 1, 2 and 3.—Curves Showing Discharge of Ford-Washburn Storage Battery.

The diagrams represent one continuous curve.

It is an unusual thing for the Ford-Washburn Co. to examine their cells while being recharged. As there are no plates or grids whatever and no way for the active material to get out of its porous cup, no examination is required, except at long intervals, for there is really nothing to need attention or repairs. As the rate of charging can be 25 amperes or higher without any injury to the battery, the company justly claims another point of superiority. It intreested and delighted the electricians present to see Mr. Washburn pick up stray short bits of copper wire of various sizes and attach them across terminals of any cell he happened to be near without the least concern for the welfare of the cell; the wire would simply smoke, sizzle and burn off. A comparison was then made between the elements of the Ford-Washburn battery and the broken-down and broken-up grids of other storage batteries of the old type of manufacture which had been subjected to the same treatment.

The elements of the Ford-Washburn battery, which had been in use for nearly a year, were as good as new, while the grids of its companion cells were in various stages of fracture and disintegration.

Before the party left, the Ford-Washburn Co. was put in possession of an order for several thousand cells, which will necessitate an immediate and considerable increase of facilities. It is the intention of the company to open a branch office in New York City at the earliest possible moment, where a good-sized battery of its storage cells will be permanently on exhibition. It is not unlikely, also, that after the car has been exhibited at the coming Street Railway Convention in Cleveland it will be seen running in the streets of New York. As the trolley is as yet unknown in the heart of New York City, the car will, perhaps, not create the comment bestowed upon it in Cleveland on the day of the test, when a little street urchin shouted, with some perturbation: "Mister, your trolley is broke!"

THE PHYSICS OF THE VOLTAIC ARC.[1]

THIS paper by Prof. S. P. Thompson, F. R. S., refers to recent work which he has carried out in conjunction with Mr. Eustace Thomas and Mr. Portheim. The potential difference of the steady arc is about 40 volts. Part of this is constant, independent of the current and the length of the arc. This constant part, 35 to 39 volts, has also been called the back electromotive force of the arc, and its seat has been found by Prof. Thompson to be at the crater. The great absorption of energy there might be due to the volatilization of carbon; the light intensity at the crater is indeed a constant, according to Captain Abney. Quite recently, however, Mr. Crookes has observed that the flaming discharges produced at high alternations and high voltage are endothermic flames of nitrogen and oxygen, that is, they absorb heat. Prof. Thompson, therefore, surrounded the arc with a glass tube into which various gases were introduced; the back electromotive force was not altered; the possible combination of nitrogen and oxygen; has, therefore, nothing to do with the electromotive forces observed. Small variations may, however, be due to endothermic actions. The gases have, of course, to enter in a gentle current, as any blowing raises the voltage very much (up to 75 volts in air), and the nature of the gas affects the crater. With carbonic acid and chlorine the crater and the negative cone flatten out. Hydrocarbons deposit soot all round; in oxygen, both carbons burn away very fast.

PHOTOGRAPHS OF ELECTRICAL DISCHARGES.[2]

MR. CAMPBELL SWINTON lets the sparks of a Wimshurst machine strike a gelatino-bromide plate which is simply placed between the electrodes. Negative sparks are like graceful palm leaves and feathery; positive less regular, and more ramified like rootlets. Alternate discharges from a Tesla coil show both figures superposed. Mr. J. Brown, of Belfast, who exhibited some beautiful spark photographs at the Bath meeting, ascribed them to an electrographic or electro-chemical, and not to ordinary light action. Mr. Swinton seems to have disproved this. He covered his plates partly with mica and ebonite; the obaque ebonite prevented the effect, the transparent mica did not. The character of the film has no influence. The plates are covered with metal foil at the back.

STRONG'S VERTICAL TRIPLE-EXPANSION ENGINE.

THE engine shown in the accompanying illustrations has been designed to meet the demand for a compact machine suitable for driving dynamos, and for other purposes where it is desirable to economize space, to secure economy in fuel, and to utilize the higher ranges of expansion, either as a condensing or non-condensing engine. There are many places where it is not practicable to use a condenser on account of the scarcity of condensing water, and as it is possible to secure about the same economy with very high steam pressure without condensation this engine has been designed to fulfil that end. It has been the aim of the designer, Mr. Geo. S. Strong, the well-known mechanical engineer, of this city, to put a triple-expansion engine into the simplest and most compact form, and at the same time to meet all the requirements that are considered necessary for general efficiency and economy.

A peculiarity of the design is that the engine is self-contained and balanced. The reciprocating parts of the two sides have simultaneous opposite movements, the cranks being 180 degrees apart, and thus, in a manner, balancing each other. In consequenee of this, and the fact that each side is independently balanced by a counter-weight on the crank, less foundation is required and more quiet running is produced than would otherwise be the case. This is very important in buildings where jarring from engines is very annoying. If it is desired that the engine shall be absolutely noiseless it can be placed upon a foundation insulated on the bottom by cork from the foundations of the building, while on the sides packing or other material can be used that will not transmit noise or vibrations to the walls.

To meet the requirements of an engine using steam of 180 to 200 lbs. pressure, piston valves have been selected for the high and intermediate cylinders and gridiron slide valves for the low pressure cylinders. By this means frictionless valves for the high and intermediate cylinders, where the pressure is high, are secured. In those cylinders the matter of clearance is comparatively unimportant. In the low pressure cylinders, however, small clearances are very necessary for economy and are brought about by the use of the gridiron valves in the cylinder heads.

The high and intermediate cylinders are double acting, while the low pressure cylinders are single acting with trunk pistons, which act as cross-heads for the engine. The piston rods extending up through from the low pressure cylinders, carry the two pistons, one of the high and the other of the intermediate cylinders. The steam is admitted to the high-pressure cylinders by a central piston valve, located in the same valve chamber, and between the two piston valves that exhaust the steam from the high-pressure cylinder, on to the piston of the intermediate cylinder. This first valve admits steam to the high-pressure cylinders, and cuts it off according to the requirements of the engine to maintain a uniform speed, but does not exhaust it, the exhaust being controlled by the end valves, as described.

The movement to this central valve is transmitted through the solid valve stem, which works through the hollow valve stem that operates the two end valves. This solid valve stem is worked from the link block, which block is controlled by the governor, while the hollow valve stem that controls the movement of the end valves, receives its motion from the pin in the end of the link, and has a constant travel.

The two end valves exhaust the steam from the two ends of the intermediate cylinder into the passages which lead to the gridiron slide valves that admit the steam into the low-pressure cylinders and it is exhausted from the low-pressure cylinders through the gridiron valves situated on the outside and in this same casting which forms the heads of the high and intermediate, and also the heads of the low. Thus all the valves are in the one casting that joins the high and intermediate cylinders. This casting is finished entirely by boring, as all the valves are intro-

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[1] Abstract of a paper read at the Edinburgh meeting of the British Asso.

[2] From a paper read before the British Association at Edinburgh.

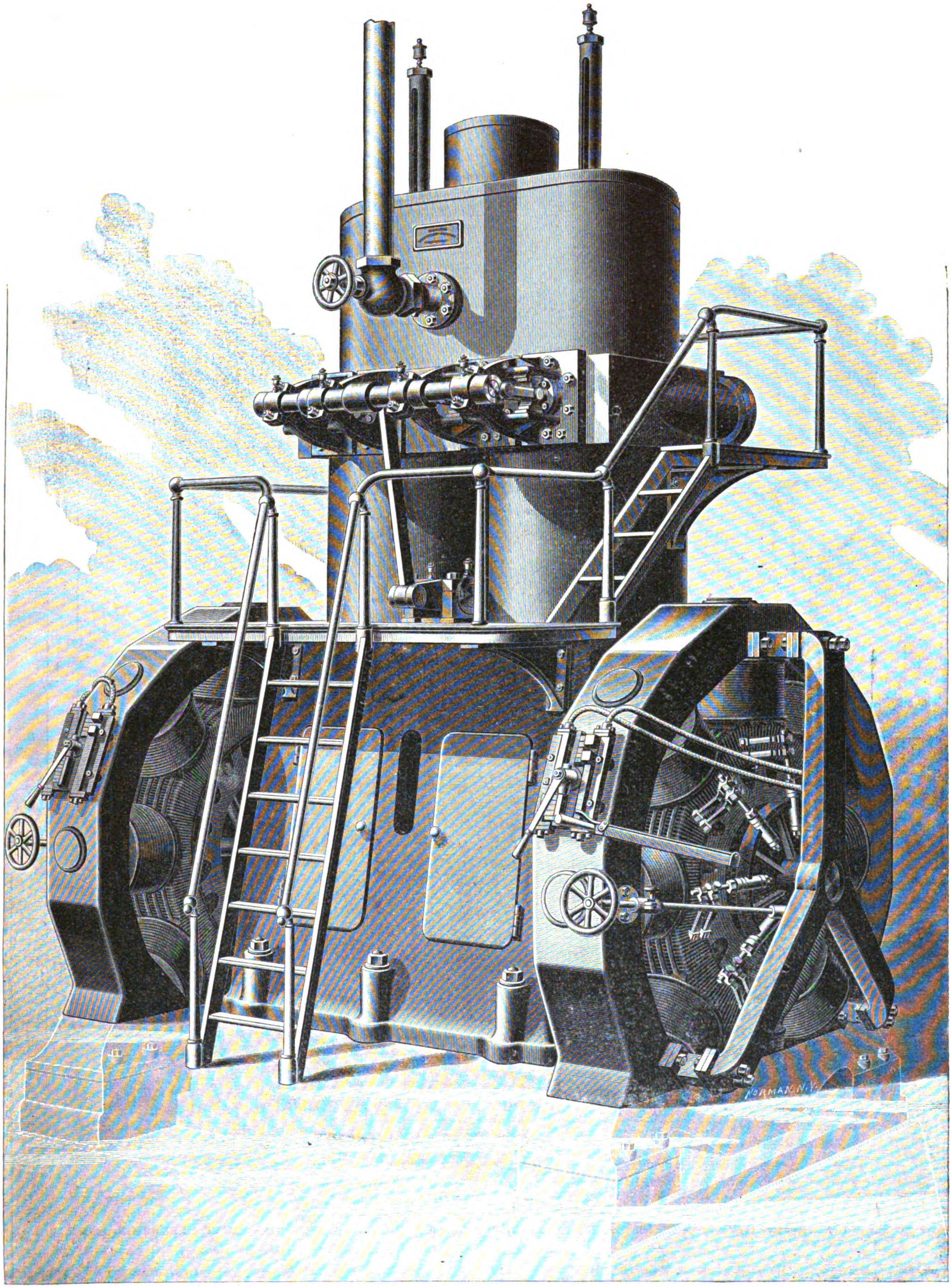

FIG. 1.—THE STRONG VERTICAL TRIPLE EXPANSION DIRECT CONNECTED ENGINE.

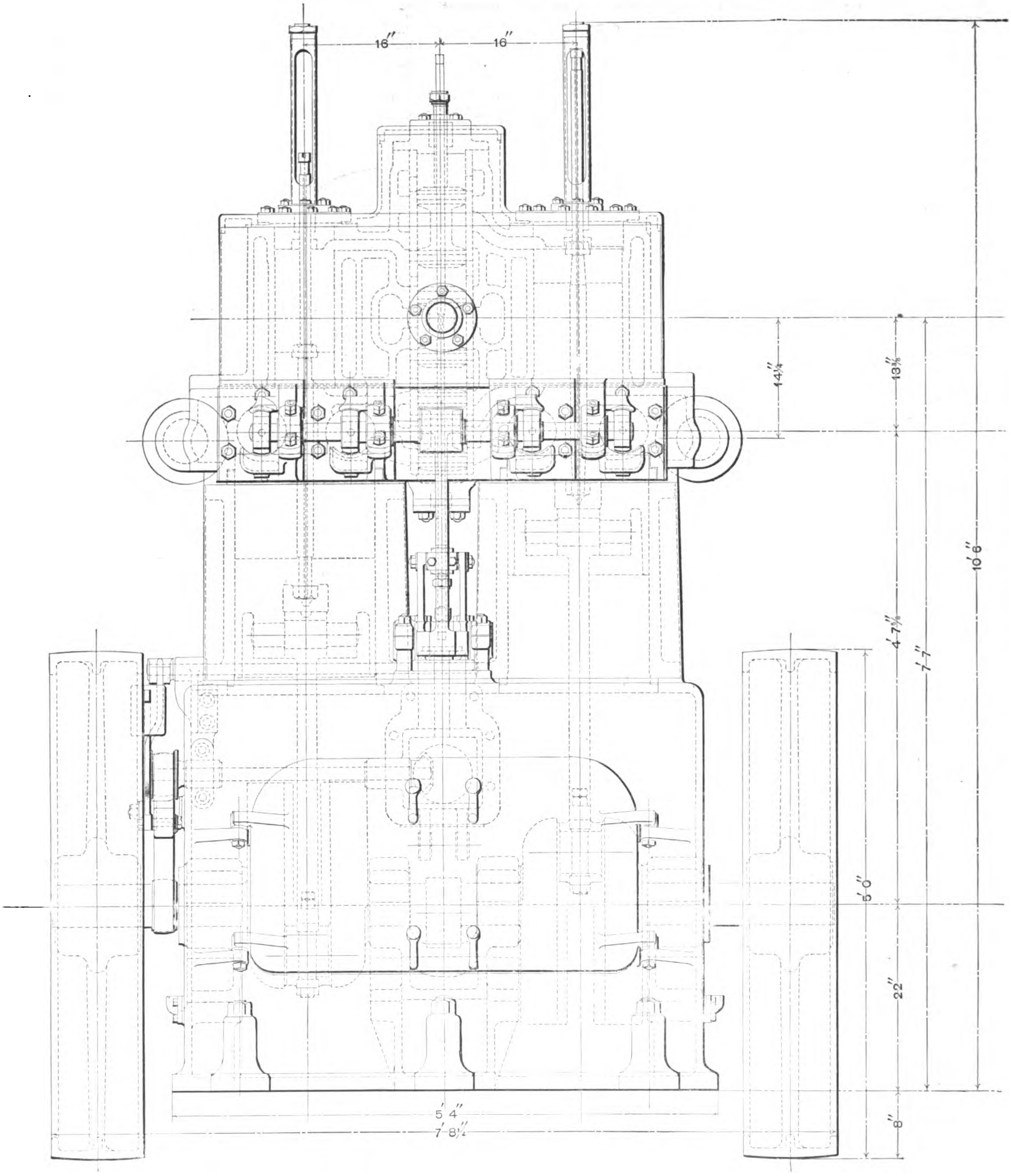

FIG. 2.—THE STRONG VERTICAL TRIPLE EXPANSION DIRECT CONNECTED ENGINE—FRONT ELEVATION.

duced by borings. The valve seats of the gridiron valves are taper plugs with the valve faces milled or planed in them so as to make a plain flat-faced valve in a cylindrical seat which can be easily introduced and easily removed, or replaced.

The piston valve of the high pressure cylinder is actuated by a block sliding in the well-known Fink link, so designed as to give a perfectly equal lap and lead, and at the same time equal cut-offs at both ends of the cylinder. The position of this block, and, therefore, the cut-off, is

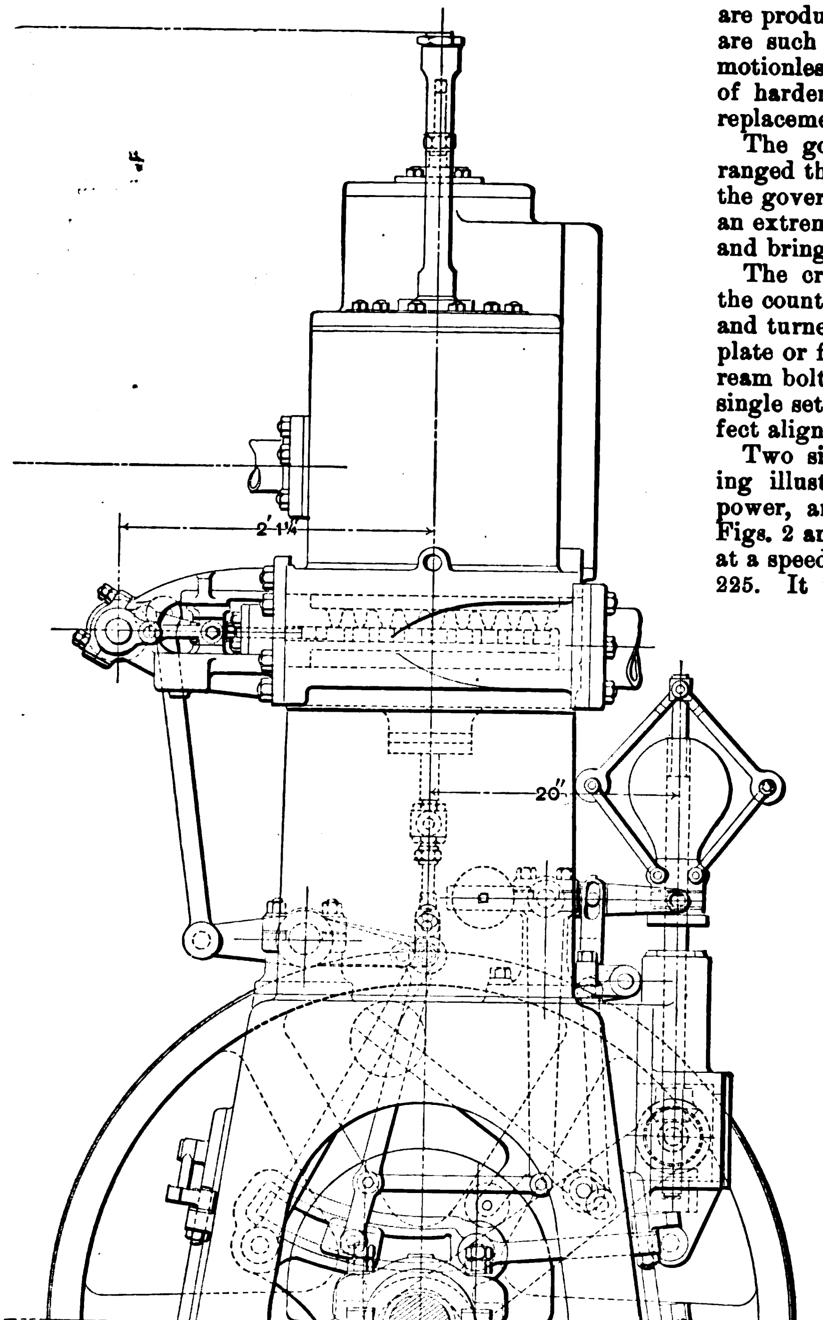

Fig. 3.—The Strong Vertical Triple Expansion, Direct Connected Engine—Side Elevation.

controlled by a sensitive high-speed governor, the resistance to the movement of which is very slight. The exhaust of the high pressure cylinder and the admission and exhaust of the intermediate cylinder are controlled by a connection to a fixed point at one end of the link. These valves have a fixed travel and point of cut-off. The movements of the low pressure valves, both inlet and exhaust, are produced by the same connection to the Fink link, and are such that when these valves are unbalanced they are motionless. All pins and bushings in the valve gear are of hardened steel, thus reducing the wear and rendering replacement easy.

The governor is provided with a safety device, so arranged that in case the governor belt breaks, the arms of the governor will be elevated and the link block thrown to an extreme position, thus cutting off the supply of steam and bringing the engine to a stop.

The crank shaft is forged from a solid steel ingot, and the counter-weight is bolted on. The pedestals are bored, and turned on their bases to fit a bored seat in the bedplate or frame of the engine, to which they are secured by ream bolts. The seats for these pedestals are bored by a single setting of a boring bar, and are consequently in perfect alignment.

Two sizes of this engine are shown in the accompanying illustrations, Fig. 1 being of 150 indicated horse power, and the other, of which two views are given in Figs. 2 and 3, of 250 indicated horse power. The first runs at a speed of 300 revolutions per minute and the second at 225. It is the intention of the builders to manufacture these engines in sizes up to 2,500 h. p.

The engine is manufactured by the Providence Steam Engine Co., who build the well-known and excellent Greene automatic cut-off engine. The details of the engine have been worked out under the supervision of Mr. F. W. Dean, of Boston, Mass.

ELECTRIC LUMINOSITY OF VACUUM TUBES.

In the course of a discussion before the British Association on a paper by Prof. Schuster on "Primary and Secondary Cells," Mr. Crookes stated that if a long vacuum tube containing oxygen exhausted to a point giving the greatest luminosity is held somewhere near a plate connected with one of the terminals of a high-tension coil, it becomes very luminous. If the tube has been lighted and put in a cool, dark place, and thereafter held near a coil, it remains dark, and no amount of placing it near the coil will make it luminous. If the tube is rubbed, it suddenly flashes into luminosity, and remains so; but if laid down in a dark room for an hour, it becomes non-sensitive again. It seemed to him that the gas inside the tube requires to be put in a state of dissassociation. Prof. H. Von Helmholtz, who was one of the lions of the meeting, said he believed that in these vacuum tubes, if there is a little stratum of gas adhering to the surface there are always molecules, which can be separated into positive and negative. There is really a measurable stratum of air adhering to the interior of the glass tubes. If a rarefied vacuum is made, the greater part of that air goes away; but there are always traces of gas left, even in the vacuum of a glass tube which is completely melted.

TESLA MOTORS IN EUROPE.

We understand upon good authority that the reports current in Europe as to the control of Tesla motors secured there by leading concerns are well founded. Three of the largest engineering firms on the continent have acquired the rights for the motor in their respective territories and will proceed to introduce it on a large scale. The concerns are, Ganz & Co. of Buda Pest; the Helios Co. of Cologne, and Schneider & Co. of Creusot, France. The delays usually attendant upon commercial negotiations have been unduly prolonged by the conditions of affairs in Europe; but now that the ground has been cleared, work will be actively pushed. In this country, the Westinghouse Co. have the control of the Tesla motor, and will now push it vigorously.

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EDITORIAL ANNOUNCEMENTS.

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

VOL. XIV. NEW YORK, SEPTEMBER 28, 1892. No. 230.

Electric railroading is here for our upbuilding and national prosperity, as surely as steam railroading was fifty years ago.—G. W. Mansfield.

THE STATE STREET RAILWAY MEETING.

WHILE a very quiet and unpretentious affair in its way, the annual meeting of the Street Railway Association of the State of New York is not to be despised, and the convention this year at Saratoga Springs accomplished, as usual, some interesting and valuable work. We have our doubts as to the likelihood that State associations will increase. They have been tried in the electric light field and have failed, and now that the tendency towards unification of ownership of the lines in each community is so marked it may be questioned whether the street railway interests can maintain many gatherings outside the yearly national one. In a large state like New York, however, there will always be plenty of material for a strong and influential association, and it should be the aim of every street railway man to lend his support to the body. This year, at Saratoga, a most significant new departure was made in the formation of a supply men's association to work in co-operation with the street railway organization on all matters in which support may be desirable. We should not be surprised to see this action repeated on a larger scale next month, at Cleveland, and we would certainly commend it to the notice of the electric light and supply trade, some well-meaning members of which have more than once imagined that their interests lay in antagonizing the National Electric Light Association.

It must strike everybody that, no matter how much New York City may have lagged behind, New York State is wholly and heartily committed to the electric railway. At this meeting, all the roads represented were electric, and the resolutions adopted congratulating this city on the starting of its first trolley cars showed how eagerly the State at large has been waiting for this city to fall into line. Not only was this so, but the address of President Beckley and the report of the executive committee both commended electricity, and the remainder of the session was given up to the discussion of Mr. L. H. McIntire's able paper on the present situation of affairs in electric traction.

There are a number of important questions raised in Mr. McIntire's survey of the various departments of work, and the opinions he expresses are not likely to be accepted by everybody, though it may be hard to gainsay him. Thus it is evident that he favors a deep girder rail, and would abandon the supplementary wiring of the tracks, depending entirely on good bonds. He believes that very few eight-wheel cars will be seen. His preference is for a medium sized car. He likes the multipolar generators and is in favor, therefore, of large units, but is wary of saying what a "large unit" is. He offers the excellent and timely suggestion that there should be a better method of designating the actual capacity of motors. "Horse power" means absolutely nothing, and perhaps Mr. McIntire's idea that motors should be rated by the draw-bar pull, is the most feasible plan. A point that was touched on in the paper and taken up in the discussion was the means of helping passengers to distinguish cars at night-time. Where a company runs a dozen lines and wisely has all its cars alike, so as to be available for any single line, it becomes a serious question how to distinguish cars simply and easily at night. Colored lights don't appear to be adequate, even with big bull's-eyes.

SPECIAL AND SPECTACULAR LIGHTING.

THE present issue of this journal furnishes remarkable evidence as to the growing appreciation of the electric light for decorative purposes and as a special feature of attraction. Mr. Shaw's interesting article reveals the modern search light installed on the top of Mount Washington, at the expense of railways and hotel proprietors, and irradiating the country for a hundred miles with its flashing dots and dashes. Should we ever talk with Mars it must be in some such way, one would think, but in the meantime, it is evident that a new method of earthly communication has been secured.

While Mount Washington affords one illustration of the flexibility and utility of the electric light, the illuminations at St. Louis, of which we give a detailed account, supply the other example. The Emerson Company has shown remarkable ingenuity in this work, which opens up a new and valuable department of applied electricity. Last year at Detroit, as this year at Washington, the Grand Army Encampment has seen some beautiful electrical displays, and New York and Chicago during the coming Columbus celebration will again exemplify the advantages and beauties of this modern form of decoration.

Stanley Transformer Tests.

THE theory of transformer action is gradually getting to be thoroughly understood and may be said to follow in a certain time lag upon the improvements in transformers. We are constantly recording increased efficiencies at all loads, and this week publish the results obtained by Prof. H. J. Ryan on a Stanley transformer. The results obtained leave little room for doubt that the lightly loaded transformer will soon lose its terrors for the station manager.

THE ACME STORAGE BATTERY FOR STREET RAILWAY WORK.

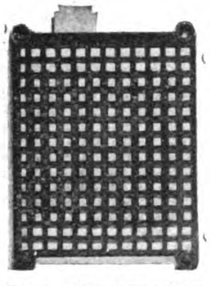


Fig. 1.—The Acme Storage Battery Plate.

When the first elevated railway in New York was put in operation, not many years ago, it was believed that the question of rapid and economical transit for its inhabitants had been solved, not only for the present but for many years to come, but in less than a decade it was found that the facilities which they offered were inadequate to the demands of the public. The result has been that the rate of speed on these roads now exceeds but very little that of the horse cars. Pending the construction of underground railways the surface roads are still taxed to their very utmost and have for years been seeking to increase the carrying capacity of their lines in which one important element is increased speed of their cars with higher economy in the motive power than can be obtained by means of horses. The success of electric traction in other cities in the United States has pointed the way to the solution of this problem but the objection to the employment of the trolley has naturally brought about the consideration by the New York companies of storage batteries for the propulsion of their cars. The experiments which have already been carried out in this city have not lacked in demonstrating the feasibility of this method of operation, which indeed is now well established by the cars in operation abroad, especially in Paris. It may be safely claimed, however, that if storage battery cars, properly equipped, were put upon a road in New York City to the entire exclusion of horses the result would be entirely satisfactory. That the faith of street car managers in this respect is still unshaken is evident by the renewed attempts which are being made, and we are glad to be able to note that the Ninth Avenue Railway Company, in this city, has again taken up the subject with a view to the adoption of storage battery cars.

As a preliminary step this company has given the Acme Storage Battery Manufacturing Co., of this city, an opportunity of demonstrating the feasibility of storage traction, and we were last week privileged to ride upon the car equipped with the Acme cells. This car, which weighs 6½ tons, is equipped with 144 cells, each weighing 27 pounds complete, and having a capacity of 140 ampere hours at an average discharge rate of 25 amperes. The car left the stables, at Fifty-fourth street and 9th avenue, and proceeded up the road on the regular track to One-hundred-and-sixteenth street, a distance of three miles. The grades on this road are exceedingly heavy, one of them, at the end of the route, being no less than six per cent. for a distance of more than 600 feet. On this grade the battery was called upon to deliver 75 amperes, while the average reading of the entire up-trip was 31 amperes. The time occupied was 24 minutes and 50 seconds.

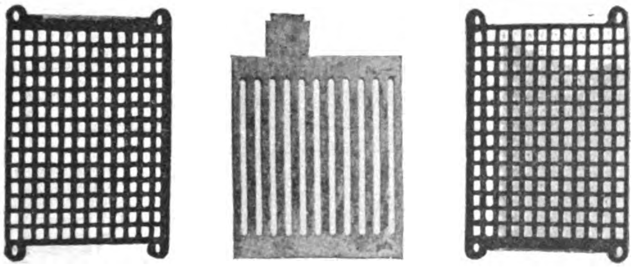


Fig. 2.—The Acme Storage Battery Plate.

On the return trip, during which the grades were mostly descending, the average current drawn from the battery was only 19 amperes, or little more than half of that required on the up-trip, the time occupied being 22 minutes and 30 seconds. The entire trip of six miles was made in 47 minutes and 20 seconds, and the car in every way operated smoothly and was shown to be under perfect control, eliciting much favorable comment from a number of street railway officials, and others present, who undertook the trip.

The Acme Storage Battery Manufacturing Company have started out to develop every detail in their work and employ a specially designed motor. Much of the success of such a system must naturally depend upon the battery employed and to this branch the company has devoted particular attention. Their aim has been to construct a cell which, while having the least weight for its storage capacity, shall, at the same time, be so constructed as to avoid the deteriorating influences which have in the past caused rapid destruction of storage cells employed in this class of work. In the carrying out of these designs the company has employed a storage battery built up in a special manner, which is well illustrated in the accompanying engravings. Each plate consists of a thin, slotted sheet of lead having a projecting tongue for making connection between adjacent plates. This thin sheet is then surrounded by the active material which is held in place by grids made of insulating material which are placed on either side. The four holes shown at the corners of the grids serve for the insertion of the bolts, which maintain the grids in position, and, passing through the successive elements, bind them all into one solid mass which is able to successfully withstand the severe service imposed by street car traction. The engraving Fig. 1 shows one plate with the grids complete. Fig. 2 shows the grids and lead sheet taken apart.

The company operating the car are confident that with the improved battery above described and their motor they can show the economy of storage battery traction, and it is to be hoped that they will be afforded every opportunity for their present tests.

A BIOGRAPHICAL SKETCH OF THE KHOTINSKY ACCUMULATOR.—III.

BY

Capt A. de Khotinsky

In November, 1881, the manufacture of gaufré accumulators was transferred from the laboratory of *l'Electricien* to that of my established manufactory at Rue des Martyres. Here I had opportunity to make an improvement by performing the soldering by electricity instead of by tin.

At this time my friend, Prof. Latschinoff, of St. Petersburg, experimented in my factory at Paris with a solution of lead oxide in caustic soda, to produce electrolytically from this spongy lead and peroxide. These experiments determined me to make an accumulator in which spongy lead was used as an electrode. I pressed spongy lead together in plates and laid between every second plate a lead plate perforated with holes, and wrapped up the whole in a perforated leaden case, as shown in Fig. 12.

This electrode was soldered electrically. The negative plates had twice the weight of the positive plates, because by this time I had accepted the gas theory for the work of accumulators. In May, 1882, in this way, I completed a secondary battery which gave me satisfactory results in the following respects :

1. The formation was accomplished without necessarily changing the polarity in forming it.
2. The forming required not more than three days, after

which time the spongy lead in the positive electrode was completely changed to peroxide.

3. The quantity of accumulated energy was three times greater per kilogram (weight) than with the gaufré accumulator, after the latter had been charged for a month.

All these advantages determined me to devote myself to earnest attention to this new construction. I went therefore to London to see Mr. W. H. Preece, chief electrician of the postal telegraphs, to show him my new element, to get his opinion, and ask for his advice as to the steps I must take for the practical commercial realization of my battery. I had charged my cell completely in Paris, then removed the acid and covered the plates with wet felt to keep them in a moist condition.

After my arrival at London, I filled the cell again with a ten per cent. acid solution. Mr. Preece requested his engineer, Mr. Cooper, to measure the capacity of the present charge in the cell, and Mr. Kempe to measure the resistance of the cells. After two days I went to Mr. Preece to obtain information about the results of these tests. Mr. Preece appeared to be satisfied with the results thereof, and told me he would for commercial realization recommend me to Mr. Arnold White, at that time director of the Edison Company in London, and at the same time president of the British Insulite Company, Limited, in London. Mr. Preece also advised me to immediately apply for a patent.

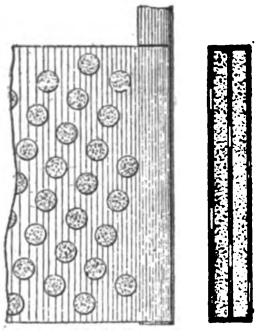


FIG. 12.

After I had made an agreement with Mr. Arnold White, I returned to Paris to arrange for my establishment in London.

In the manufactory of the British Insulite Company in Charlton, a place was assigned me, where I prepared for constructing an experimental battery.

After some months this battery was ready and I could make public experiments for the board of the Insulite Company and others interested. These turned out very satisfactory. To my sorrow, I found that the company was in want of capital, and I was therefore compelled to discontinue for a while my further experiments, of which I shall speak later.

THE "BRAIN" ELECTRIC TRAMWAY SYSTEM.

In our last issue we gave a general description of the above tramway system, to illustrate the operation of which an experimental line has been laid down at the Telegraph Construction Company's works at Helsby, England. We are now enabled to place before our readers further illustrations of this system, for which we are indebted to *Industries*. In Fig. 1 a view showing details of the permanent way are given. Fig. 2 shows a side elevation of the under frame of a car showing the method of connecting the collector trolley to the car frame, and Figs. 3 and 4 show respectively side elevation and sectional view of the collector trolley. Figs. 5 and 6 show enlarged sections of the cover rail and slot in the conduit, the cover rail being shown both seated in its bed and raised similar to when a car is passing.

From Figs. 3 and 4 it will be seen that the carrier frame and contact arrangement are carried on a strong girder G, which is shown connecting the two rollers T that run on the surface of the cover rail. The contact arrangement consists of a sliding contact piece or shoe B, which is attached at each end to the lever rod L, of about $\frac{3}{8}$-inch square steel. Both these levers are moved by one flat steel spring S; thus a constant downward pressure is maintained against the conductor A. The levers (being square) and the upper part of the contact shoe B are fitted into a strong lock frame, in which they work easily. This lock frame is well enameled and insulated, and let into a solid block of hardwood, previously treated with a hardening hydrocarbon insulating liquid. In position, the block overhangs the metal of the box-lock frame like the deep cup of an insulator. The whole is like a long insulator cup with the lock frame up inside. This travels along the slot opening of the conduit, and the thickness of insulation on each side of the metal is more than twice the total width admissible in an open conduit slot. From the contact shoe B the current is taken by the strip conductor D to the grip Z, and from thence by the cable C to the car; W W are the carrier wheels supporting the cover rail B.

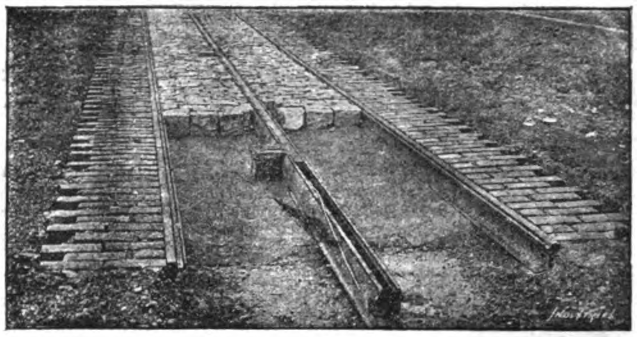


FIG. 1.—THE BRAIN ELECTRIC RAILWAY CONDUIT.

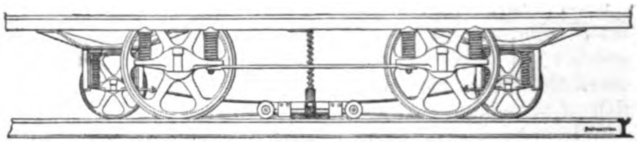
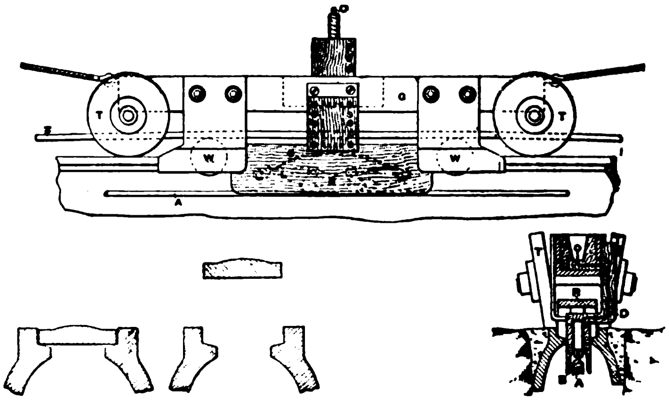


FIG. 2.



FIGS. 3, 4, 5 AND 6.

At the turnouts and all crossings, the conductors can be made continuous, as at their junctions they are simply made to present a flattened surface over which the contact shoe can easily slide in either direction.

SPECIAL ELECTRICAL ILLUMINATIONS AT ST. LOUIS, MO.

The ready adaptability of the incandescent and the arc lamp to decorative effects is now so generally recognized that these methods of illumination are being employed to the almost entire exclusion of others. The ease with which wires can be run and made to conform to any outline makes the work of illuminating arches or set pieces of any description a comparatively simple matter, while, on the other hand, where changeable light effects are desired the electric method is facile princeps.

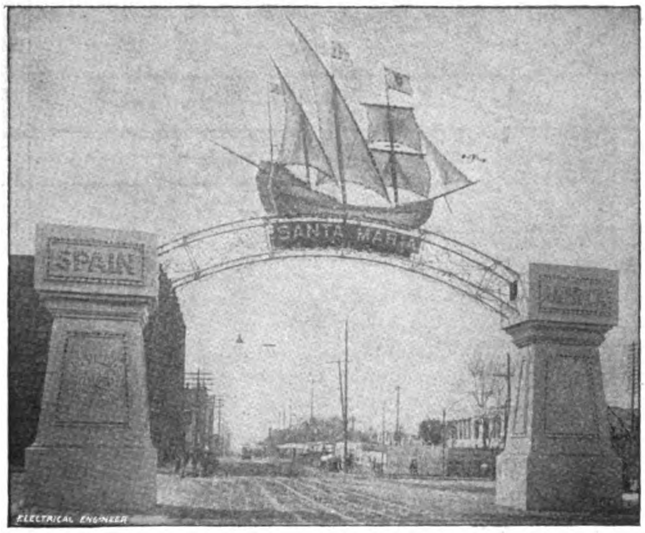


Fig. 1.—The "Santa Maria" Electric Arch.

No better illustration of this could have been found than was exhibited in the illuminations gotten up in connection with the recent autumn festivities and Columbus celebration at St. Louis. These lighting effects, which were all carried out by the Emerson Electric Manufacturing Co., of St. Louis, deserve more than passing notice, and may be said to have constituted the crowning feature of the festivities.

Probably the most elaborate piece is the "Santa Maria" arch, Fig. 1, located on 12th street, between Market and Chestnut streets. The extreme outside dimension of the arch is 70 feet, and the inside distance, from column to column, 45 feet. It spans the double track of the Union Depot Railroad (electric line) and has a clearance of 34 feet at the centre. The arch is made of $2\frac{1}{2}$-inch iron pipe, with special cast iron fittings, and is held together with $\frac{3}{4}$-inch tie rods. The pillars are of wood built around 3-inch iron pipe and a telegraph pole. The ship itself is of $\frac{3}{8}$-inch wood, covered with canvas, and painted.

The electrical apparatus is arranged in three circuits, with separate 500 ampere knife switches. The first circuit includes the ship "Santa Maria;" the second circuit includes all the lights representing the waves, and the third includes all the lights in the columns, names and borders.

The first and third circuit are controlled directly by the switches, while the second circuit is cut in by the switch but goes through an improved contact cylinder driven by a one-eighth horse power Meston alternate current motor. The cylinder takes the different circuits of the waves. By means of the cylinder an excellent imitation of wave motion is obtained. This design is alike on both sides, thus constituting a "double design."

The first circuit contains no less than 750 lights; the second circuit 520, and the third 600 lights, making a total of 1,870 lights. Not the slightest hitch has occurred with this arch since the current was first thrown on, several weeks ago. The highest light is 61 feet above the railroad tracks. Current is supplied by 18 Stanley 100-light converters, situated in the west pillar.

An equally effective piece though of a different nature is the "Flag Arch," Fig. 4, showing side byside the American flag and that of Columbus. This arch is located on 12th street, between Olive and Locust streets, over the statue of Gen. U. S. Grant. The circle enclosing the statue is 25 feet in diameter. The side columns are 19 ft. high, surmounted by four wooden balls representing cannon balls, and an eagle, the distance to the top of the flag pole being 45 feet. Both flags cover an area of 10 x 13 feet. The flag pole and supporting arch are made of iron pipe, the flags being of wood as are also the columns.

The American flag is, of course, red, white and blue. That of Columbus represents the one said to have been given him by Queen Isabella, when he left Palos. It has a white ground, gold border, gold crown and cross, and bears the letters F and Y in green, standing for Ferdinand and Isabella. This is not a Catholic flag as a great many suppose, but the personal ensign of Christopher Columbus.

The lights are divided into two circuits. The first circuit is controlled entirely by its switch. The second comes through its switch and is then divided by one of the Emerson Co.'s cylinders as in the "Santa Maria" arch. This circuit contains all the lights of the flags, each of which is divided into eight circuits. The first circuit of each flag is connected together and then led to the cylinder, and so on with the rest of the circuits. The first circuit contains 590 lights, and the second 630 lights, making a total of 1,220 lights supplied by 11 Stanley converters.

The converters are placed back of the statue and covered over; the cylinder is in the west column. This piece is also a double design.

The piece known as "The New World Pole," which is illustrated in Fig. 2, is located on 12th street, just south of St. Charles street, being one block from the works of the Emerson Co.

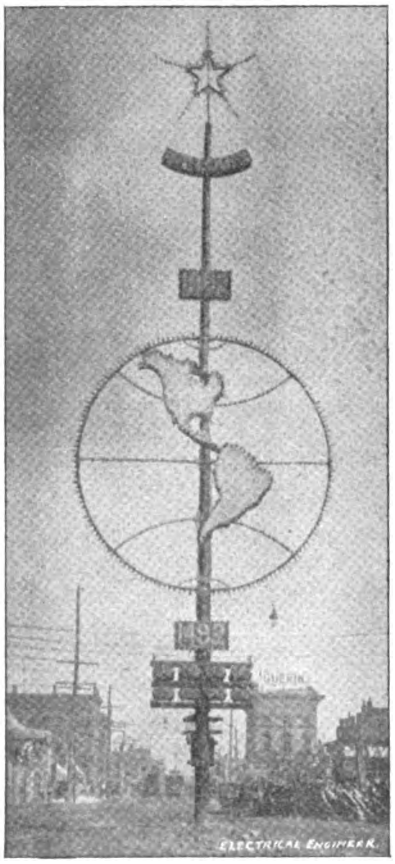


Fig. 2.—The "New World" Electric Standard.

This is the design that was shown, in part, at the St.

Louis Exposition this Spring. It is built around a telegraph pole, about 14 inches at the butt. The circumference of the circle and pipes supporting it are held to the pole by special castings. The circle is 25 feet in diameter and the highest lamp is 93 feet from the ground, being the first lamp in the upper streamer of the star. The continent is made of wood, painted white, and all the iron work and the pole are painted black. There is but one 1,000 ampere knife switch employed with this piece. The different circuits are led to a "duplex contact cylinder" which is shown in the engraving, Fig. 3.

The lights are arranged in the following order : 1. Red lamps in circle ; 2. White lamps in circle ; 3. Blue lamps in circle ; 4. Border of dates ; 5. "1492" and single lamp for "San Salvador ;" 6. The lights begin at the Gulf of Mexico and go around the continent to about New Foundland and down to the mouth of the Amazon, when all the rest of the continent comes in with the geographical circles. 7. "1892 ;" 8. St. Louis and Star ; 9. The circle is made to appear to revolve ; 10. When the circle is revolving the star is made to twinkle.

It is said the flashing of this star 90 feet high can be seen for miles on a clear night. In this piece there are 1,360 lights fed by Stanley 100-light converters. The "New World" cylinder is operated by a duplex cylinder driven by a $\frac{1}{8}$ h. p. Meston alternating current motor at 105 volts. The vertical cylinder brings in all the different effects as mentioned above and at a certain time the horizontal or fast cylinder is cut in and gives the twinkle to the star and the revolving to the circle. There are 24 distinct circuits in this cylinder.

The "Pyrotechnic Arch" is located at Seventeenth and Olive streets, just at the crown of a hill, from which it can be seen a long distance in either direction, especially from the west.

This arch has a span of 38 feet and a clearance of 25 feet. It begins at the centre of the board and lights up each of the designs separately, then the lights flow out, as it were, along the supports and up the pole by degrees until the umbrella is reached, where it remains a while, then goes out, and then begins over again.

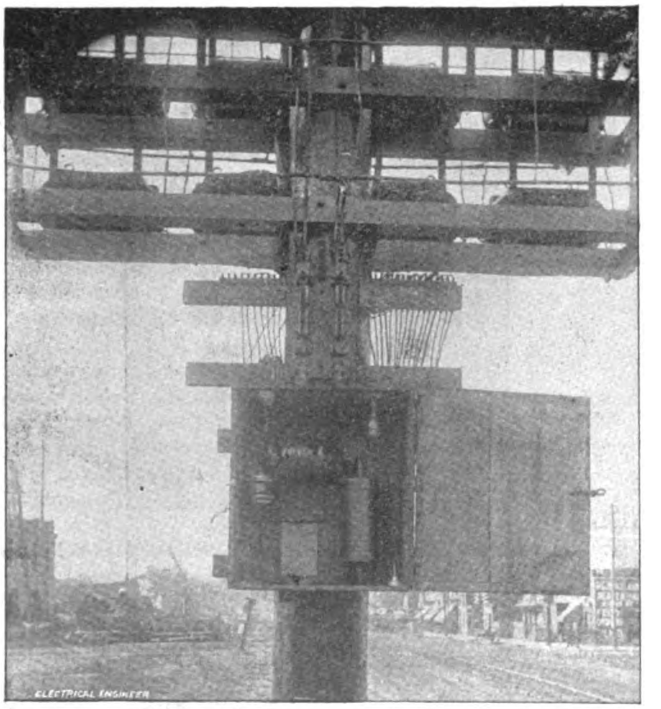


FIG. 3.—CYLINDER SWITCH FOR CONTROLLING ILLUMINATIONS.

There are 650 lights arranged in 20 distinct circuits, in this arch, controlled by a 500-ampere knife switch and a single contact cylinder driven by a $\frac{1}{8}$ h. p. motor.

The "Columbus Arch" is located at the corner of Olive and Thirteenth streets, just east of the Exposition Building. Its dimensions are the same as those of the "Pyrotechnic Arch." It bears a transparency of Columbus in the centre, lit up by 380 lights and one arc light in the interior. This piece has no moving effects.

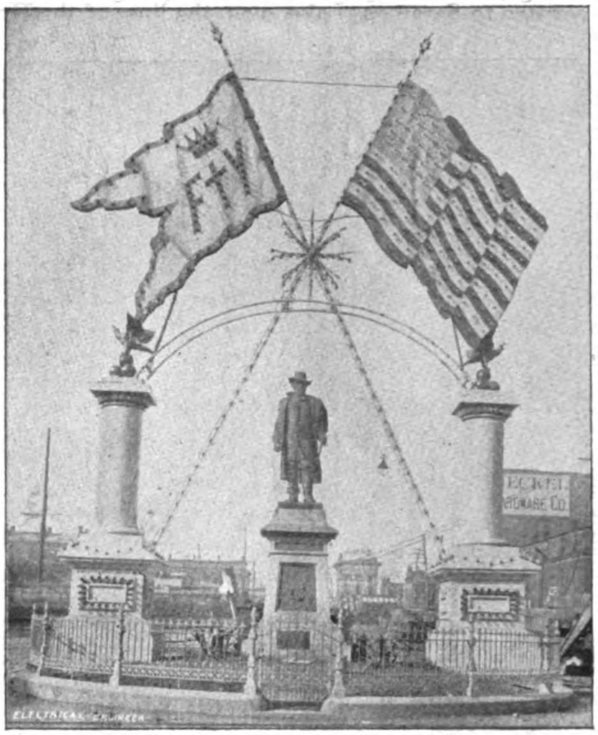


FIG. 4.—THE "FLAG" ELECTRIC ARCH, ST. LOUIS.

The "Washington Transparency" is located at the corner of Broadway and Washington avenue. It is placed on top of a boulevard pole of the Lindell Street Railway Company (electric line). The transparency is illuminated from within by means of an arc light and the borders are out-lined by 140 lamps run from a Brush converter.

These pieces constitute probably the most elaborate installations of this character thus far undertaken in this country and might afford valuable suggestions to the numerous Columbus celebration committees now at work.

Patent Notes.

THE CARPENTER ENAMEL RHEOSTAT.

IN a patent just issued to Mr. Chas. E. Carpenter, entitled, Rheostat, No. 481,781, Aug. 30, 1892, the inventor describes the ingenious enamel rheostats recently illustrated in our columns. The patent is assigned to the Carpenter Enamel Rheostat Co., of Bridgeport, Conn., and is claimed to cover the controlling features of this form of rheostat. The patent was filed Feb. 18, 1891, and contains the following claims :

1. A rheostat or resistance comprising a base plate corrugated, ribbed, or recessed on the rear face thereof and provided with a coating of enamel or similar vitreous material on the front face and resistance coils or sections embodied in such coating, substantially as and for the purpose described.

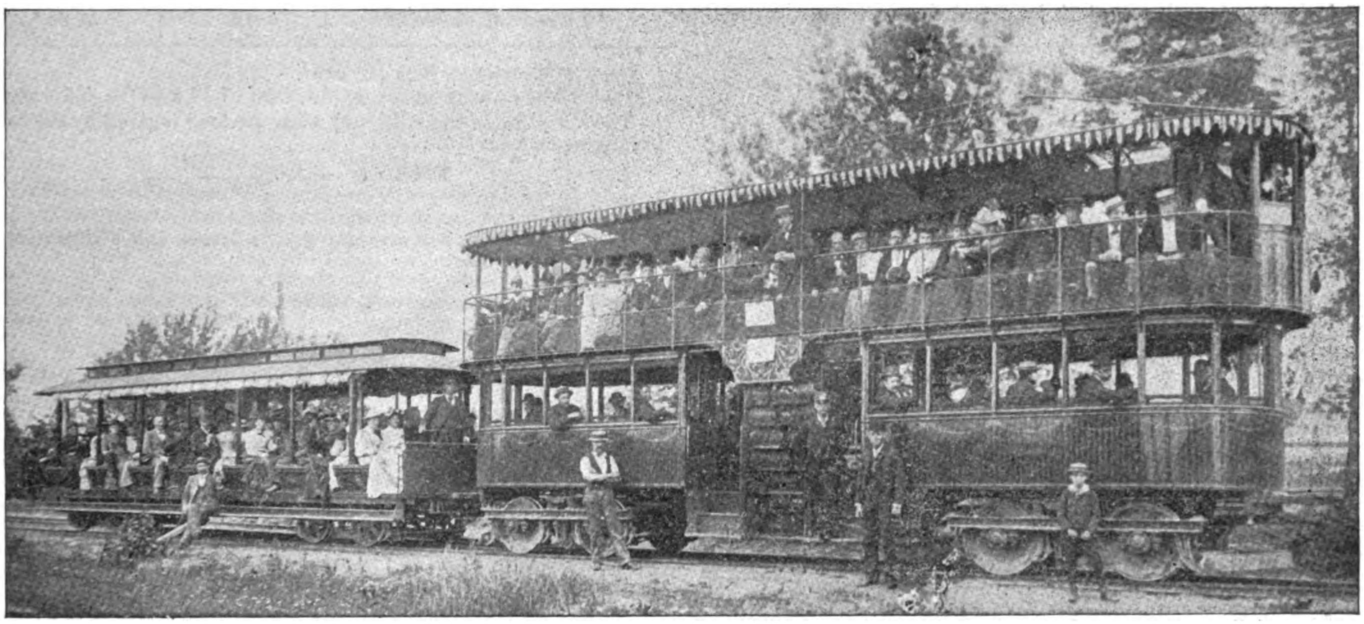
2. A rheostat comprising a base plate provided with a coating of enamel or similar vitreous material, a series of resistance coils or sections, and a corresponding series of contact blocks therefor embedded in such coating, and a switch key co-operating with such series of blocks, substantially as described.

3. A rheostat comprising a base plate provided with a coating of enamel or similar vitreous material, a series of resistance coils or sections, and connecting wires embedded in said coating beneath the surface thereof, but out of contact with the base plate, a corresponding series of contact blocks also embedded in said coating, but projecting beyond the surface of the same, and a switch key co-operating with the series of blocks, substantially as and for the purpose described.

We understand that applications for a number of additional patents of importance covering the manufacture of enamel rheostats will soon be put through the Patent Office.

THE PULLMAN DOUBLE-DECKED ELECTRIC CARS AT SARATOGA SPRINGS.

One of the most interesting features of the meeting of the New York State Street Railway Association last week at Saratoga, was the trip made from the Springs out through the country to Saratoga Lake, over the line of the Union Electric Railway Co., by invitation of Mr. C. E. Arnold, the president of the company. The ride was made in a car of the new centre vestibule, upper-seat type, now being introduced by the Pullman Co., of Chicago, and as few of the street railway men even had seen these cars, the element of curiosity intensified the pleasure of the excursion. It was a critical party, but unless the signs are greatly mistaken, it was a verdict of approval that was given. The opinion of the writer—who was present, and who has ridden on every type of electric car, since Mr. Leo Daft experimented with his at Saratoga nine years ago—is one of entire approval. It seems to him that such cars must solve the problems of heavy summer travel, and meet many conditions of normal traffic on crowded city lines.



The Pullman Double Deck Car at Saratoga Springs, N. Y.

A picture is here given of the car with a trailer. There are four of these double-deckers on the road, which has also eight Pullman trailers, four single-truck motor cars, and five single truck trail cars, or twenty-one cars in all, the motor and power equipment being of Thomson-Houston make. As will be observed from our illustration, the Pullman double decker is eight-wheeled, and consists below of two compartments. It is 32 feet long over the body proper, and has a total length of 33 feet 7 inches. Its body width is 7 feet 4 inches, and its height is 14 feet 9½ inches. Each of the lower compartments is 12 feet long. The lower floor will seat 40 passengers, and the upper 40 more; while many times during the past season the car has carried 150 passengers for several successive trips, as well as hauled its trailer. It has even done much better than that, but of course the capacity is limited by the ability of the motors, which are two of 25 h. p. each. The spiral stairways occupy about the same space—eight feet—as is usually devoted to the end platforms, and the pilot houses are up on the second deck, handy to the trolley and giving a fine point of vantage for looking well ahead on the track. The upper deck is covered in by a very handsome and substantial canopy, and the car above and below is well lighted by no fewer than 25 incandescent lamps. The Pullman trucks that carry the admirably distributed weight of the car are fitted with Allen paper wheels.

Judging from personal experience, riding in these cars is a most agreeable pastime. In the lower compartments, one seems to be occupying a choice seat in an observation car on a steam road. Upstairs the seats are broad, easy and nicely shaded. Even when the car has its heavier load on top, with the down stairs compartments nearly empty, it travels easily and smoothly with very little, if any, tendency to tilting. This stability, due to a low centre of gravity, was particularly noticeable at high rates of speed, both on grades and curves, the rate made ranging from 8 up to fully 25 miles an hour.

The road is new, having started only on July 1, but thanks to these cars and their enormous carrying capacity, it has been a pronounced success and has done a very large business. The road has often carried in a day from Saratoga Springs to the Lake, 3,000 passengers at 25 cents the round trip; 1,500 to the Geyser Spring at 10 cents and 1,000 to the Race Track, when the races are on, at 20 cents. These are excellent rates of fare, but the road has found it possible to get them and to be inconveniently crowded. Provided with such sumptuous and enjoyable accommodations, the public that visits Saratoga has felt itself well treated, and the patronage has been of the kind that always responds to liberality of management. In conversation with officers of the road, the writer learned that so far as they could discover, it took practically not an ampere more of current out of the station to run one of these cars than it did to run one of the ordinary motor cars, and yet the earning capacity was doubled absolutely.

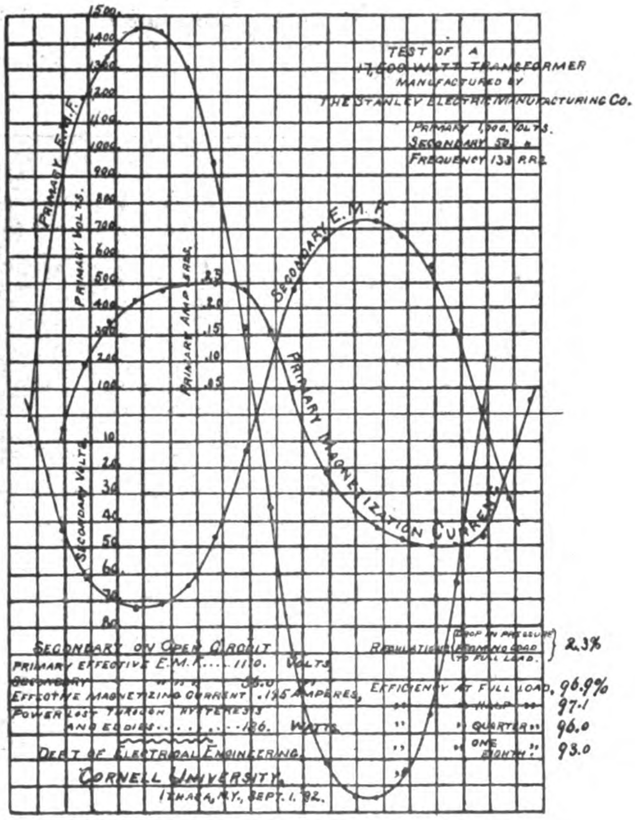
THE TOMMASI MULTIPOLAR ACCUMULATOR.

The Tommasi accumulator is now being manufactured in three sizes by Messrs. Rouart Bros., of Paris. Their charging current varies from 1 to 4 amperes per kilogramme of plates, and the discharge from 1 to 3 amperes. The available capacity in ampere hours, under a discharge of 1 to 3 amperes per kilogramme, is 20 ampere hours per kilogramme. The price of the accumulators is 30 francs per ampere hour. The Tommasi multitubular, it will be recalled, is formed of electrodes enclosed in a sheath of insulating material pierced with holes. In the centre of the sheath is a lead conductor in contact with a layer of oxide.

TEST OF A STANLEY 17,500-WATT TRANSFORMER.[1]

The method employed for testing your 17,500-watt 1,000 x 50 volt transformer for a frequency of 132 periods per second, was as follows:

The power dissipated through hysteresis, eddy currents, etc., was determined by the use of a contact maker, condenser, and electrometer as described in the paper on transformers in the *Proceedings* of the American Institute of Electrical Engineers, Vol. vii, p. 1. The transformer received current from a Westinghouse alternator at 132 p. p. s. This machine was driven by a high speed 60 h. p. tandem compound automatic engine, that has a fair speed regulation. It was found in the outstart, however, that the total loss of power in the transformer at full load was in the neighborhood of but 3 per cent. of the load. On account of the natural drift of the speed of the engine within certain limits, it was not found practicable to measure the total power delivered to the transformer and that given out by it with such a degree of accuracy that the probable error would be less than 1 per cent. This would mean a probable error in the determination of the total power dissipated by the transformer of 30 per cent.



Test of Stanley Transformer.

Were there no magnetic leakage in transformers, we would get a measure of the power lost through heating of the primary and secondary conductors by the product of the drop in volts observed on the secondary into the current output of the same. This measure would then be rigidly accurate when the secondary is at work on incandescent lamps, and the primary magnetizing current is as small as it is for this transformer. Actually, however, there is always some magnetic leakage that increases with the output of each transformer, and lowers the E. M. F. of the secondary by lessening the magnetization through the same. Since this action results in no waste of power, in ignoring its presence we shall make an error that counts against the transformer. It is highly probable that in a transformer with a drop in pressure due to load of only 2 or 2½ per cent., the error thus made against the efficiency at full load will not amount to more than ⅛ per cent.

The drop of secondary pressure due to load was observed by taking simultaneous readings of the effective pressure at the terminal of the primary and secondary when the transformer was loaded with lamps to an output of 17,500 watts and when it was unloaded. In this way errors due to the drift of the speed of the engine are eliminated.

The accompanying diagram with its curves gives graphically the observations made for determining the power taken up by the transformer with the secondary on open circuit. From the curves of primary impressed E. M. F. and primary current the power lost through hysteresis and eddies in the iron core, was determined to be 186 watts with the pressure at the primary terminals of 1,110 volts. It is desirable to know the power lost at the standard pressure of 1,000 volts. In making this deduction we have assumed that this loss varies as the 1.7 power of the magnetic density in the iron core. The power lost in the transformer on open circuit at a primary pressure of 1,000 volts is therefore 157 watts.

The drop in the secondary pressure due to load was determined from the following effective primary and secondary pressure readings which are given as the mean of a number of observations:

Full Load.		No Load.	
Primary.	Secondary.	Primary.	Secondary.
1,077	53.30	1,122	57.03

Reduced to a primary pressure of 1,000 volts:

Full Load.		No Load.	
Primary.	Secondary.	Primary.	Secondary.
1,000	49.67	1,000	50.83

Drop 1.16 volts, or 2.32 per cent.

Power lost in heating the conductors: 1.16 x 350 = 406 watts.

The variation of the efficiency with the load is given by the following equation:

$$\text{Efficiency} = 100 \frac{W}{W + H + K^2}$$

Where W = the output of the transformer in watts;
H = the power lost through hysteresis and eddies in the core;
K^2 depends upon the effective resistance.

Substituting the numerical values of H and K, we have:

$$\text{Efficiency} = 100 \frac{W}{W + 157 + .00000132\, W^2}$$

The efficiencies at full load, half load, quarter load and one-eighth load are 96.9, 97.1, 96.0 and 93.0 per cent, respectively. For one 16 c. p. lamp the efficiency is about 24 per cent.

For a determination of the all-day efficiency when the primary pressure is kept up at all hours of the day it is assumed that this transformer would have a working output equivalent to 17,500 watts for five hours out of every 24. Under these conditions the all-day efficiency is 93.8 per cent.

(Signed) Harris J. Ryan,
Department of Electrical Engineering,
R. H. Thurston, Director. Sibley College, Cornell University.

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[1] Report of Cornell University to the Stanley Electric Mfg. Co. The tests were carried out by Prof. Harris J. Ryan.

GOVERNING WATER WHEELS.

In the last issue of The Electrical Engineer I noticed an article on the difficulties of governing water wheels when the load under which they operate varies. The writer of the article has pointed out the reason why it is impossible to design as quick-acting a water wheel governor as some of our steam engine governors. The remedy he suggests when viewed from a practical electrical standpoint can hardly be recommended.

Whenever we have to deal with water powers having a small head and a large volume, I think the best plan is to use as quick acting a governor as circumstances will allow, and in addition, use either a very heavy fly-wheel or a generator having an armature of very large diameter, such as has been placed on the market by the General Electric Co., Siemens & Halske and others.

For water powers operating under a large head, I think the best plan is to use a deflecting nozzle such as is employed by the Pelton Water Wheel Co. With this device, whenever the load is diminished, the nozzle is deflected so that but part of the water stream strikes the buckets. This, together with as large and heavy a wheel as feasible ought to make a very good governor. It is, of course, for the water wheel companies to say whether any practical difficulties prevent the use of this device.

The amount of water used in this case will be always the same whether the generator is working under light or full load, but this is not of great importance, as it would, as a rule, be very foolish to try to use a water power when only sufficient water for the average load is available. A successful water power plant requires an abundance of water during all seasons of the year.

Wm. M. Schlesinger.

Butte, Mont., Sept. 16, 1892.

TENTH ANNUAL MEETING OF THE NEW YORK STREET RAILWAY ASSOCIATION.

THE tenth annual meeting of the N. Y. Street Railway Association was held at the United States Hotel, Saratoga Springs, on September 20.

The following gentlemen were present:

John W. McNamara, president, Albany Railway, Albany; Daniel F. Lewis, president, Brooklyn City Railroad Co., Brooklyn; W. J. Richardson, secretary, Atlantic Avenue Railroad Co., Brooklyn; Joseph A. Powers, superintendent, Glens Falls Electric Railway, Glens Falls; John N. Beckley, president, and Charles J. Bissell, counsel, Rochester Railway Co., Rochester; Charles Cleminshaw, president, and Charles H. Smith, superintendent, Troy and Lansingburgh Railroad Co., Troy; T. R. Taltavall, *Street Railway News*; T. C. Martin, THE ELECTRICAL ENGINEER; James H. McGraw and C. B. Fairchild, *Street Railway Journal*; M. J. Sullivan and E. S. Reynolds, *Street Railway Gazette*; F. L. Kenfield, *Street Railway Review*; and N. D, Webster, *Electrical World*; H. C. Evans, Johnson Company; J. A. Hanna, McGuire Truck Company; W. F. D. Crane, W. H. Johns Mfg. Co.; D. W. Pugh, John Stephenson Co.; W. J. Clark, A. Lewis, and Prof. Feary, General Electric Company; W. H. Delaney, Royaline Mfg. Co.; W. S. Silver, Graduated Car Spring Co.; F. D. Russell and E. Packer, Rochester Car Wheel Co.; C. S. Merrill, Engineering Equipment Co.; G. N. McKibben, Reed & McKibben; Elmer Morris, Thomson-Houston Co.; J. E. Wallace, Smith & Wallace; A. R. Cook, Q. & C. Co.; J. F. Ostrom, Pennsylvania Steel Co.; Frank R. Ford, Short Electric Railway Co.; Willard S. Brown, American Casualty and Insurance Co.; John Patterson, Taylor Truck Co.; Frank A. Magee, The E. S. Greeley & Co.; J. H. Jones, West Troy, and Louis Pfingst, Boston.

Mr. John N. Beckley, of Rochester, president, made the following address:

PRESIDENT'S ADDRESS.

Gentlemen.—The year past has been without special incident, so far as the street railroad interests of the State are concerned. I shall take your time but a few moments in giving a brief summary of the record of the year, and in calling your attention to a few practical matters.

Many members of the Association feared that the street railroad interests would be subjected to uncalled-for attacks on the part of the legislature at its late session, and much apprehension was felt that unjust and hostile legislation might be successful in impairing the value and usefulness of street railroad properties throughout the State. The Executive Committee of this Association took early action, looking to the protection of our common interests. The report of the work done by the committee in this regard, will, I am sure meet your approval. The success which has attended the efforts put forth is evident to every member of the Association. No bill striking street railroad interests, and no bill which injuriously affected street railroad interests became a law. The obligation of protecting the properties which we are called upon to manage against adverse and iniquitous legislation is often lost sight of. Certain of our brethren seem to rely upon the success of efforts which they trust will be put forth by others who, perhaps, have no larger interests to protect than have they.

The most important function of a State street railroad association is to furnish information to the members of the legislature as to the needs of street railroad companies, and to combat before legislative committees, and in personal intercourse with senators and assemblymen the erroneous propositions which are often advanced without adequate knowledge of the condition of things. A great majority of the members of our legislature are honest men, who, when informed of the facts will act intelligently without injury to any legitimate industry or business. There always have been and there always will be others in every legislative body, who take advantage of every opportunity which ingenuity can suggest, to strike corporations by the medium of unjust and hostile legislation. Thus far, the street railroad companies of the State have not been injured by unwise or dishonest legislation. But immunity cannot always be secured, except as the result of diligent and intelligent effort on the part of the street railroad companies themselves. A fair and intelligent presentation of the facts as they exist, made at the proper time, I believe will always protect the interests with which we are identified; but such presentation ought to be made by the representative of this Association, and such representative ought to stand for every street railroad corporation in the State.

I trust the time will very soon come when every street railroad company in this Commonwealth will not only have its name enrolled on the books of this Association, but will be as well an active, earnest and enthusiastic member. Our interests are common, our efforts should be united.

During the past year much progress has been made in the education of the people of the larger cities of the State upon the subject of the "Trolley System" of propelling street cars. Even in the city of New York, where a year ago it seemed electric cars could never be operated, because of the intense and unreasonable prejudice of the people, franchises are being obtained, and there is every reason to believe that the old-fashioned, slow-moving and nuisance-causing horse car system of that great and prosperous city, will soon give place on all the lines to the modern systems of propulsion by electricity or cable.

Our Brooklyn friends have carried on their campaign of education with skill and unceasing effort, and the complete success of such effort seems now to be assured. So, throughout the State, until as error, ignorance and hostile interests are cleared away, the people of every community are coming to realize that they live in the last decade, and not in the middle of the 19th century. The improvements which have been made in electric and cable railroad appliances, machinery and construction, may be said to have kept pace with the demand for the same. The electric motor of to-day represents a great advance over the electric motor of last year, and the cable roads under construction in the city of New York represent the cable system at its best.

We shall have the pleasure and the honor to-day of listening to papers from two gentlemen, each of whom is in the front rank of his profession, and from them we shall learn what science, skill and experience have done in perfecting the two systems of street car propulsion, which are doing so much to make life the more worth living in the cities of our State.

Street railroad men are learning that in the management of our properties it pays to be liberal. I do not mean that it is wise to be extravagant, or reckless, or improvident in the management of such properties, but that a broad and progressive policy, which furnishes to the people increased facilities for travel, adds to the net income to be derived from the operation of street railroads. The public, as most of us have come to know, are quick to appreciate improvements made, and as quick to respond with their nickels to the effort of a company to intelligently and efficiently serve them.

It seems to me wise and in accordance with the best business principles, to keep a little in advance of the reasonable demands of the people, with reference to improvements, additions and extensions. I do not mean that a company should heed the request or demand of a hundred families to extend a line where it will require 1,000 families to support that line when extended. But constructing an extension somewhat, perhaps, in advance of the time, when such extension will pay operating expenses, is, in my opinion, as a rule, the wise thing for a railroad company to do. The same principle obtains as to number of the cars to be run on each line, and as to other improvements and betterments of the system. We depend upon the people for our patronage and every street railroad man knows that a good feeling on the part of the people towards the company which serves them, adds to the receipts of the line, makes it easier to obtain needed concessions from city governments, as well as from individuals, and prevents the granting of franchises on parallel lines to competing companies where, perhaps, only one line can be made a commercial success.

While upon this subject of liberality of treatment on the part of railroad companies, I desire to call your attention to the advisability from a business standpoint of adopting, whenever local conditions will warrant, a transfer system. It seems to railroad companies who now obtain two fares from passengers, who desire to go from one part of the city to another by means of the cars on two lines, that the income of the company must necessarily be decreased if passengers are carried for a single fare of five cents.

After a careful study of this whole question, we decided at Rochester to introduce a transfer system, under which a passenger can ride from any point in that city reached by the lines of the Rochester Railway Company to any other point reached by said lines for a single fare. We commenced giving transfers on this plan on the 5th day of October last. We provided reasonable restrictions and necessary conditions. The experiment has proved an undoubted success, not only from the standpoint of the passenger but from the point of view of the company as well. There is no question but that the receipts of the company have been materially increased by the adoption and use of the transfer system. Perhaps the location of lines and other local conditions prevailing in other cities of the State may prevent the successful introduction of a transfer system. But I thought it might be of interest to members of the Association to know of the pronounced financial success of the undertaking, so far as the Rochester Railway Company is concerned.

Until March 1st the conductors and motormen of the Rochester Railway Company were paid the same wages as were formerly paid to conductors and drivers of horse cars. We very soon found after commencing operating electric cars, that we required men of higher capacity to perform the duties of motormen and conductors than seemed to be necessary with the old system. It seemed to us that as the duties of the positions which the men held under the new system were more onerous and exacting, and as it required more judgment and skill to properly handle electric cars, the men should be paid a somewhat higher compensation than they had before received. Therefore, the company, before the men themselves made any request for an increase of wages, advanced such wages. The action of the company gave, of course, great satisfaction to the men, and the result has been very beneficial, so far as the company itself is concerned. It has been found that while the item "wages of employees" has been materially increased, the cost of operating the road per mile has in fact been diminished. This is accounted for in the fact that the men are more attentive to duty than before and more careful in the handling of cars; in greater freedom from accidents and in the material lessening in the cost of maintenance.

I am satisfied that the management of many street railroad corporations, where electricity is the motive power, have not as yet given sufficient attention to the thorough instruction of their motormen as well as conductors, as to the function of each part of the motor and as to the proper thing to be done by the motorman and conductor when trouble develops while the car is in service on the line.

Some weeks since I had occasion while riding on an electric car in a city of another State, to ask the motorman some questions about the motors he was running. I found he did not know whether the motors were Thomson-Houston, Westinghouse, Edison or Short. He did not know whether they were double or single reduction. He did not even know whether he had under his car body one or two motors. I asked him what he did in case he had any trouble on the line? He said, "If the motor don't work I wait until another car comes along and pushes me in." I found that this motorman had been for nearly nine months in regular service as motorman in that city. This motorman knew enough to turn on and turn off the current, and to set and loosen the brakes. This, of course, is an extreme case, but it illustrates the principle. My own judgment is, based upon some experience, that too much pains cannot be taken to thoroughly instruct the motorman as well as the conductor, so that each will know the cause of trouble when trouble develops in either of the motors in service.

The plan the company with which I am connected has adopted is to select from among the motormen one of the men who is pronounced by the master mechanic, the electrician, and the superintendent, the best posted as to the construction and use of a motor and make such man, for the time being, instructor of motormen on cars in actual service. This instructor rides with motorman after motorman, observes the manner in which he handles his car under all conditions and gives detailed instruction as to exactly what to do whenever trouble of the usual sort develops. The instructor spends from half a day to three days with each man until he pronounces him in every way qualified to run a car on every portion of the line and to do that which needs to be done when trouble develops.

I might call your attention to many other matters of practical interest if occasion seemed to call for further statement. It is perhaps presuming in me, to say what I have said, addressing as I am many who have had more experience than I. My only object in calling your attention to the matters I have referred to, is to make some suggestions which may be of value to some who have had less experience than I have, brief and limited though that experience may be.

REPORT OF EXECUTIVE COMMITTEE.

The report of the executive committee stated that the Association had twenty companies in its first class of membership and five in the new second class. It stated that there had been no strikes during the year, and that the outlook was an encouraging one. As to electric traction, it said: "Electricity has been booming in this State since we last met. Brooklyn, fortunately for its citizens, will soon be blessed with the overhead system on a scale nowhere equaled in the world; the very best construction both for track and overhead work having been adopted throughout the city. When fully developed to successful operation in that city, the system will bring about the condition of things throughout the country by the substitution of electricity for horses, set forth in the advertisement of a famous patent medicine, of which it is declared the 'children cry for it.' Already some of the leading dailies of New York City are beginning to change their hitherto insane abuse of the so-called 'deadly trolley,' that has never yet killed one human being; and they will soon be tumbling over one another in their enthusiastic advocacy of a system regarding which they have finally decided to learn something; and no longer to depend upon their imagination for their facts. Whatever recent improvements with manifest merit have been made in the electric system will be hailed with delight by those interested in this form of motive power."

The report was signed by Daniel F. Lewis, John N. Beckley, C. Cleminshaw and W. J. Richardson.

Mr. C. J. Bissell made an interesting report of his work as counsel in watching legislation at Albany.

It was suggested by Mr. Lewis, that the Association would be stronger if the smaller companies came in, and if the supply men would help in various ways. The suggestion was acted on later in the day.

The paper on "Cable Traction," expected from Mr. G. W. McNulty, engineer of the Broadway road, New York, was not presented, as the road is not yet running by cable.

Mr. L. H. McIntire, the engineer of the Union Co. of New York, then read the

REPORT OF COMMITTEE ON RECENT IMPROVEMENTS IN ELECTRIC TRACTION.

We understand that anything which tends to an increase of reliability or economy of operation of an electric railway is an improvement; and it is with the intention of bringing before you in a brief manner the results of my experience and observation during the past year upon these points that this article has been written.

As you, of course, know, electric systems as first constructed, were built on altogether too light a plan, and the increasing tendency year by year has been, and is, for heavier and more solid construction in every department, but particularly in the way of track and station equipments. It has been well said that no new departure is ever perfect at the beginning, and no one realizes this more than he who has watched the development of electric traction during the last few years.

The storage battery has made but little progress during the past year, and is not likely to cut much of a figure in electric traction until it is able to make a better showing, financially, than it has in the past.

It may seem strange that the management of roads, even at present operated by horses, cannot see that a change of some kind must come soon owing to the great cry for rapid transit; and yet I know of roads at present being laid with flat centre-bearing rails on stringers in streets being newly paved. I do not mention this as an "improvement," but simply to show that what may be regarded as an improvement by some would be called simply a makeshift or temporary piece of work by others.

The general tendency of the times to consolidate all common interests under one management is showing its effects in electric traction, more now than ever, and scarcely a week passes that we do not hear of some syndicate obtaining control of some horse-road, and the information usually ends with the statement that "it is intended to equip all the lines with electricity." From many points of view this is an improvement and a marked one.

TRACK.

The improvement in track construction has been very great, and although many expensive errors have been made, we ought, on the whole, to feel satisfied with the progress.

The early forms of track construction were too light and soon went to pieces; but during the past year heavier rails have been rolled and better joint plates made, so that it is possible to keep the road-bed in perfect line and surface. This improvement has been a great help to the electric equipment and has reduced the cost of maintenance. As the cost of laying tracks is about the same, whether light or heavy, it is economy to put in only the best.

Now on the question of what constitutes the best form of track, there is considerable variance of opinion. My experience and observation has convinced me that the deep girder rail, about nine inches high, spiked directly to the ties, is the best form for paved streets, and in dirt or Macadam streets, a six-inch girder rail laid in the same manner. In the country and where the local authorities are willing, I would lay a T-rail, spiked directly to the ties.

The weakest place in all forms of track construction is at the joint. Every manufacturer of rails, and many of the railroad companies, have tried to overcome this trouble. There are probably as many patents upon rail joints as upon car couplers, and most of them about as impracticable. Up to the present time there has been nothing brought out which surpasses a properly designed "fish plate."

While speaking of track construction, it might be well to call attention to the bonding of rails for the return circuit. Many forms have been used, and some of them are still in operation. I believe that a No. 0 copper bond wire long enough to connect with the web of the rail on each end of the fish plate is the best plan, and then grounding the whole system at frequent intervals, and abandon the supplementary wire which it has been the custom to use with the common form of bonding.

ELECTRIC EQUIPMENT.

Probably the greatest advance in any particular line has been in the matter of armatures for motors and dynamos. I consider that the introduction of the "iron clad" type will do more towards reducing the bill for repairs in that direction than any other one thing that has been introduced during the year. The electric companies have all, I believe, now adopted this form as their standard, and all roads that have tried them will, I think, agree with me that, for simplicity, ease of repair and ability to stand the hard usage they receive, they stand at the head.

In the manner of controlling the motors most of the companies still use the time-honored rheostat; although I believe one company are endeavoring to introduce a new type of controller, which they will, doubtless, be happy to explain at a later date.

Many roads, acting under a misapprehension of the requirements, started off with motors too small for the work, and endless trouble has been the result. Some new classification should be adopted by the electrical companies for designating the power of their motors, as the present "office classification" does not afford a proper understanding of its capacity, and the "horse power" term is but little better, depending on so many limiting conditions. A more satisfactory way would be to specify the number of pounds the motor can pull at different speeds, with the maximum current for which it is designed.

TRUCKS.

The first car trucks employed in electrical work were of the pedestal form; that is, the trucks were fastened to the car body and oscillated with the car. The motors, of course, had to be suspended from the car body, and the result was that the grinding of the gears was transmitted through the whole car; also, the oscillation of the car body caused the motors to correspondingly rise and fall. This was very undesirable, and it was soon found necessary to adopt the post form, in which the truck was complete in itself and the motors supported directly on the frame of the truck. The body was connected with the truck only by springs, thus being entirely free from the jolts and pounding of the truck.

In this form slight spiral springs were first used, the same as in the previous styles, but it was soon found that the high-speed attained caused the body to oscillate to such a degree that it became very objectionable, and the different builders then modified their trucks by extending the side bars beyond the axle boxes a sufficient distance to allow an auxiliary spring to be added at each end. For this auxiliary support, coil and elliptical springs have been used, both forms with marked success, and it is now possible to carry a car body 28 feet over all, practically without oscillation. This last modification has been a very great improvement, and has settled the long car question on most street railways. I mean by this that but very few double-truck cars will be used, though, of course, there are places where two trucks can be used to advantage, and in such places they will still be employed. But where we are able to carry nearly as many people on four wheels as on eight, and to apply the power equally on each axle, so that there is no possibility of lack of traction, there can be no gain to the railroad company in using eight wheels.

CARS.

The car bodies first employed were of the same style and proportions as those used for horse roads, and were not properly designed for electrical purposes; first, the framing of the roof was too weak and would not support the trolley board properly; second, the framing of the floor was not adapted for the use to which the cars were put; for not only was the framing too weak, but it was also not well planned for putting in the trap doors which are required in order to inspect the machinery underneath the floor.

The car which it seems to me is best adapted for the present service is one 18 feet 6 inches long inside, with platforms 3 feet 6 inches long. The rafters should be strengthened with steel plates and the framing throughout should be heavier.

The coloring of the cars and the necessary signs are attracting considerable attention from the different railway companies, but up to the present time I do not think any concerted action has been taken. For my part, I believe that all of the cars on a system should be painted the same color; that is to say, each separate line should not have a distinct color, but signs should be used to designate the different routes; preferably by means of the well-known reversible sign on the top of the car both at the sides and front. At night the lines might be distinguished by the color of the ventilator glass, which would in each case be the same as the ground color of the reversible sign.

OVERHEAD CONSTRUCTION.

There has been a general improvement in all parts of the overhead material. We are using stiffer poles, stronger span wires, better trolley wire insulators and handsomer curve fittings; so that the general appearance of the system is much pleasanter. The quality of insulation now in general use is far superior to what we had two years ago, and as double insulation is now employed on the span wires, very little trouble from leakage is experienced.

The method of feeding the line is a very important matter and should receive careful attention. The best arrangement is to divide the system into several sections, so that in case of trouble along any portion of the line, such as fire, etc., that section can be cut out and the balance of the system run as usual.

THE POWER STATION.

This may be rightly called the heart of any electric system. The trolley and feeder wires form the arteries, the rails and return wires the veins, and the cars the capillaries connecting them. The Biblical injunction to "Guard thy heart with all diligence, for out of it are the issues of life," would certainly seem applicable to the station. The chief element to be considered should be reliability, and after that economy. Just what means shall be used to attain this end seems so far to have been a disputed matter, as shown by the stations now in operation, which contain almost every conceivable device, good, bad and indifferent; all shapes, sizes and descriptions of engines, boilers and dynamos. Many designers of stations—if some of them can be said to have been designed at all—seem to have gone at their task utterly regardless of the future and oblivious to the experiences of the past. However, through it all I can say that a very marked improvement is observable lately. The designers of stations are learning wisdom from their past experiences, and the makers of apparatus are more alive to the requirements of the system, and better material and workmanship can be had where required.

The recent introduction of large multipolar dynamos has brought about a change in station arrangements not heretofore obtainable, and in all large stations now being built countershafting is dispensed with entirely, and the general tendency is towards reduction of parts, which in turn means simplicity. It is very probable that we have reached now a form of station that will be fairly permanent, and the main point in the future will be the size of the units. For medium size stations engines with releasing valve gear belted direct to a multipolar dynamo will be the best where the price of land is not excessive, and direct-coupled engines and dynamos for larger stations. To my knowledge there have been no comparative tests made as to the economy of the various types of stations, although all reasoning would point to those latest types as being by far the most economical.

There has been heretofore too much taken for granted or assumed in electrical work, and the rapid growth of the business has called into it many who were totally unqualified for the positions which they obtained. I attribute much of the unsatisfactory work in the past to this course, but am happy to note that the great majority of these are passing into the background, and their places are being filled with men of good judgment and mechanical resources.

Respectfully submitted,
L. H. McIntire,
Committee.

At the close of Mr. McIntire's report, the following set of resolutions was offered by Mr. Lewis, and carried unanimously:

Whereas, The Street Railway Association of the State of New York, assembled at Saratoga Springs for its Tenth Annual Meeting, has learned that the Union Railway Company of New York has put in operation this week the first electric trolley cars within the city of New York;

Resolved, That the Association congratulates the company and the public of the greatest city in the Union upon this adoption of the latest and most improved method of street railway traction;

Resolved, That the Association earnestly deprecates the opposition manifested against the trolley system in various quarters, as being founded upon neither reason nor fact, and as being contrary to the best interests of any community seeking rapid transit facilities and suburban homes for a growing population; and

Resolved, That the Association hereby tenders to Mr. L. H. McIntire, engineer of the Union Company, its thanks for his able address on the work already accomplished in New York, and its wishes for the development in the metropolis of the system thus inaugurated.

A brisk discussion then ensued on Mr. McIntire's paper, in which Messrs. McNamara, Powers, Cleminshaw, Beckley and others took part, the points touched upon being size of units, depth and weight of rail, distinguishing cars at night, joints between rails, headlights, etc. Opinions differed as to rails and joints, but it was urged that deep rails could neglect provision for expansion as they went well into the earth and radiated the heat. Hence the rails could be put solid together. At Glens Falls, even with a 40-pound rail, Mr. Powers had adopted the solid practice of the New York Central Company as seen at Poughkeepsie; and nobody could count the joints on his road. As to distinguishing cars at night, the practice varied. At Troy, Mr. Cleminshaw had bull's eyes four times as large as usual. Mr. McNamara had tried colored rims an inch wide around the headlight. It seemed to be the opinion that now so many cars are under one management, and the cars are of uniform color, a better means of telling the cars quickly at night was needed.

Messrs. Cleminshaw, Lewis and McNamara were appointed a committee on nomination, and proposed the following names, and the gentlemen were thereupon elected: President, C. Densmore Wyman, New York; vice-president, Daniel B. Hasbrouck, New York; 2d vice-president, J. A. Powers, Glens Falls; secretary and treasurer, W. J. Richardson, Brooklyn; executive committee, D. F. Lewis, Brooklyn; John N. Beckley, Rochester; John W. McNamara, Albany.

Mr. Lewis offered an amendment to the by-laws, increasing the annual dues of members in the first-class to $50, as recommended by the executive committee, which was adopted.

The meeting then adjourned, to meet in Rochester, the third Tuesday in September, 1893.

In the afternoon those in attendance at the meeting were invited by the Union Railway Company, of Saratoga, to participate in a trip on the electric road to Saratoga Lake. The ride was enjoyed by all.

MATERIAL MEN'S AUXILIARY ASSOCIATION.

In accordance with a suggestion made in the Convention that a Material Men's Auxiliary Association should be formed, the material men present met on the U. S. Hotel piazza at 1.45 p. m.

On motion, H. C. Evans acted as chairman and appointed John

F. Ostrom, W. J. Clark and J. H. McGraw a committee to report organization and name and to name officers for ensuing year. After a trip over the line of the Union Railway Company, of Saratoga, the material men met in parlor 8, U. S. Hotel, at 5 p. m. and received the committee's report as follows:

The name of this organization shall be "Association of Dealers in Street Railway Materials, of the State of New York."

The object of the association shall be to make possible concerted action on any matters that may affect the business of its members and to aid the New York State Street Railway Association in its efforts to prevent any legislation which it may consider hostile to the interests of the street railways of the State of New York, as well as to aid it in promoting beneficial legislation.

The officers of the association shall be a president, two or more vice-presidents and a secretary and treasurer, to be elected annually.

The work of the association shall be performed by the officers and committees as follows:

A. An executive committee of nine members, to be elected annually.

B. A legislative committee of five members, to be appointed by the president annually.

The dues of the association shall be: Initiation dues, $5.00; annual dues, $5.00.

This association shall hold an annual meeting on the date and at the place of the annual meeting of the New York State Street Railway Association and other meetings at such time and place as may be called for by the president.

Membership.

Any individual, firm or corporation dealing in street railway materials, any engineer, individual, firm or corporation engaged in street railway construction work, or any trade paper published in the interest of the street railway profession, may become a member by registering with the secretary and treasurer and paying the initiation fee and annual dues.

Each member to carry one vote.

Your committee would suggest the following as officers and committee to serve for the ensuing year:

President, Wm. J. Clark, New York; vice-presidents, Jno. W. Fowler, Brooklyn; D. W. Pugh, New York; John Jones, E. J. Gilbert, Troy, N. Y.; secretary and treasurer, C. E. Stump, New York. Executive committee, W. J. Clark, New York; H. C. Evans, New York; Jno. A. Wood, New York; Wm. S. Silver, New York; C. E. Stump, New York; T. C. Martin, New York; S. W. Baldwin, New York; F. D. Russell, Rochester; D. C. Breckenridge, New York.

It would also suggest that the president be authorized to appoint a committee to perfect a constitution and by-laws as embodied in the above.

Respectfully submitted,
(Signed) JOHN F. OSTROM, Chairman.

After some discussion, the report of the committee was adopted and the officers declared elected. It was decided that only residents of New York State be eligible as officers or committeemen, and that the constitution contain such a provision; also resolved that the president be appointed a committee of one to advise with the New York State Street Railway Association and advise it of the action of the meeting.

Society and Club Notes.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

THE above association have now issued their programme, mentioned in our last issue, for their annual meeting at the New York Academy of Medicine, Oct. 4, 5 and 6. The list of papers is a long one and very interesting from the medical standpoint. Among the electrical contributors are Prof. Houston and Messrs. A. E. Kennelly and J. J. Carty. Committees are to report on standard coils and meters. On Oct. 4, after the evening meeting, the members will visit the Electric Club. On October 5 there will be a reception in the evening, with a phonograph lecture by Dr. J. Mount Bleyer. On Thursday afternoon the members will visit the Edison laboratory and see some physiological experiments with magnetism. During the convention an exhibit of electro-medical apparatus will be made by T. A. Edison, J. H. Bunnell & Co., Waite & Bartlett, The Galvano Faradic Co., W. F. Ford, Otto Flemming, McIntosh Co., Law Battery Co., etc.

A ST. LOUIS ELECTRIC CLUB.

IN view of the meeting of the National Electric Light Association in St. Louis next February, the electrical people of that city have taken steps to organize an electric club, which will be ready to extend its hospitalities at that time, and will be made a permanent society as soon thereafter as possible. A committee is actively working on the matter now.

Inventors' Record.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED SEPT. 13, 1892.

Alarms and Signals:—

Adjustable Thermostat, M. D. Compton, Newark, N. J., 482,420. Filed Nov. 21, 1891.

Employs electromagnets brought into circuit by the motion of the thermostat bar and serving to hold the bar in firm contact.

Rudder Indicator C. Cory, New York, 482,421. Filed Nov. 24, 1891.

An electrical device for indicating the position of the rudder of a vessel.

Burglar Alarm, H. T. Wilson, Louisville, Ky., 482,464. Filed March 4, 1892.

A contact device adapted for attachment to door or window casings without the necessity of channeling the casings.

Distribution:—

Means for Controlling Electric Generation, T. A. Edison, Menlo Park, N. J., 482,549. Filed March 12, 1881.

Claim follows:

The combination, with a minor consumption circuit with one or more magnetoelectric machines connected therewith, an exciting machine supplying the field circuit of the main machine or machines, means for varying the speed of the exciting machine independently of the main machine or machines, and a suitable electrical indicator indicating the condition of the main circuit.

Dynamos and Motors:—

Ventilating Armature for Dynamo-Electric Machines, E. Thomson, Lynn, Mass., 482,397. Filed April 2, 1885.

Designed especially for application to hollow armatures or armature carriers. Employs a blower. The armature shaft may be hollow.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, T. T. Eckert, New York, 482,425. Filed May 16, 1892.

Claim 3 follows:

In a galvanic battery, a zinc electrode formed of perforated zinc plates and separate zinc pins or screws, said pins or screws being employed to fasten adjoining plates together and to suspend the composite electrode from a cross-bar or other support above the cell.

Voltaic Pile, W. E. Washburn, Cedar Rapids, Iowa, 482,444. Filed June 14, 1892.

Adapted in form and structure for convenient use in therapeutics. The construction is such that the entire pile may be immersed in an exciting fluid.

Heating:—

Electrical Furnace, J. Parker, Newbridge, England, 482,586. Filed July 5, 1890.

Employs a strip or bar of conducting material on each side of a furnace, each strip having two sets or series of holes corresponding to similar openings in the walls of the furnace, one set of holes being above the other set and fitted with metallic sockets holding stationary electrodes. There are also adjustable metallic or carbon rods fitted in the lower set of holes for striking the arc when commencing to work the furnace.

Lamps and Appurtenances:—

Electric Light Fixture, E. R Crolius, Chicago, Ill., 482,339. Filed Jan. 4, 1892.

Relates to a fixture joint.

Electric Arc Lamp, H. H. Cutler, Waltham, Mass., 482,435. Filed June 25, 1891.

Relates to feed mechanism for a lamp adapted for use either on a constant potential or a constant current circuit.

Line-Wire Tightening Device for Electric Lamp Supports, C. A. Pfluger, Chicago, Ill., 482,486. Filed May 3, 1892.

Employs a rotary binding post and means for holding the post against the strain of a tightened wire.

Clamp for Arc Lamp Carbons, A. Weber, Schenectady, N. Y., 482,535. Filed Nov. 4, 1891.

Device to facilitate the work of the lamp trimmer.

Electric Arc Lamp, H. H. Bigland & J. Burns, Newcastle-on-Tyne, Eng., 482,568. Filed April 20, 1892.

Regulating apparatus, having a twist-rod, a movable carbon-holder controlled thereby, means for lifting said twist-rod and holder simultaneously, and means for imparting a rotary motion to the twist-rod at a determinate point of its lift, as and for the purpose set forth.

Miscellaneous:—

Safety Device for Electric Circuits, L. B. Atkinson, London, Eng., 482,433 Filed Sept. 12, 1891.

Employs a subsidiary circuit (shunt) protected by a fuse or cutout operating with less than the normal current carried by the main conductor.

Electrical Apparatus, L. G. Woolley, Grand Rapids, Mich., 483,668. Filed June 6, 1892.

An apparatus designed to permit the employment of current for alarm purposes and for medical purposes at one and the same time.

Railways and Appliances:—

Inclosed Conductor for Electric Railways, G. A. Dupuis, Detroit, Mich., 482,348. Filed May 16, 1891.

Employs an insulated conductor and conducting pistons or plungers reaching through the insulation at definite intervals, and friction rollers on the outer end of the pistons or plungers, the latter actuated by a traveler.

Railway Crossing Protector, R. J. M. Danley, Columbus, Ohio, 482,422, Filed March 2, 1892.

For sounding an alarm or closing a gate at a highway crossing. Employs two sets of relays operating for trains coming in either direction.

Railway Crossing Protector, R. J. M. Danley, Columbus, Ohio, 482,423. Filed April 20, 1892.

Amplification of the above.

Underground Trolley, J. Fischer, Cleveland, Ohio, 482,506. Filed March 5, 1892.

Employs an anti-friction sleeve fitting loosely on the trolley arms for protecting the latter from wear in the conduit slot.

Railway Time-Signal, W. Scott, Hot Springs, S. D., 482,699. Filed May 13, 1892.

For signaling the time of passing trains.

Electric Locomotive, W. H. Soley & W. Washington Perkins, Philadelphia, Pa., 482,594. Filed Jan. 7, 1892.

Designed to permit the car to run at a high or low rate of speed while maintaining the motor at a contant speed.

Switches and Cut-Outs:—

Automatic Electric Cut-Out, C. O. Mailloux, New York, 482,374. Filed Sept. 9, 1890.

Relates to cut-outs in which the switch is normally locked by a catch or detent operated by an electromagnet.

Telegraph:—

Telegraph Relay, W. Maver, Jr., New York, 482,440. Filed July 18, 1891.

A quick-acting relay. Claim 2 follows: In a telegraph system, the combination of a main-line conductor, relatively movable coils in series with each other and in a circuit with the main-line conductor, two portions of each coil being at an angle to two portions of the other and the remaining portions of each coil being parallel to one another, an independent or local line conductor, and a circuit-closer in circuit therewith and controlled by that coil which is movable.

Letters to the Editor.

GOVERNING WATER WHEELS.

In your issue of Sept. 14, "Mechanical Engineer" propounds a question upon the governing of water wheels. He has probably been urged to this by experience in operating them, which I do not think is peculiar to himself.

I desire to take issue with him on his suggestion of allowing the wheels to run at full gate always, and absorb what power is not required upon the electrical circuits by electrical means in the stations. It does not seem right to use and pay for the means of converting power in the basement for the sake of reconverting it to a useless end, and I think it is neither necessary nor expedient.

The fact of there being plenty of water may apply to a few large plants, but certainly not to the much larger number of smaller plants. I believe a very large majority of the water powers at present in use need all the water they can get at some periods. These powers are subject to dry seasons, hard winters and very often to limited rights of flowage, and a small reservoir capacity above the dam. In designing a central station, one of the most important features to be attained is continuous service, and therefore the above conditions cannot be ignored.

The method suggested by your correspondent, or a similar one, has been used and with some success, according to an issue of The Electrical Engineer of some months back, but two blacks do not make one white, and I wish to make some suggestions.

1. The fly-wheel is an old friend whose usefulness is in no way impaired at present, although some think that electricity should and will eventually do everything. Taking a railroad circuit, for instance, the changes of load are great, sudden, and very frequent. Under these conditions I think a fly-wheel may be designed to be of considerable service.

2. It is possible to build a turbine with arrangements for controlling the water supply, which, instead of being a "gate," may more nearly approach a "valve." This will incur expense and is scarcely possible with some types of turbines. The valve should have a large number of small openings requiring only a small motion to control it. This motion may be derived by mechanical means from variations of speed, or directly from the electrical circuit attached to the power.

Either of these methods may be used in conjunction with the fly-wheel, and will entail less expense than the absorption dynamo suggested by your correspondent, and will save a large amount of water, which is of considerable importance to a large number of plants, as already pointed out.

J. A. Cross.

New York, Sept. 19, 1892.

ACME STORAGE BATTERY MFG. CO.

This company which is incorporated under the laws of the State of New Jersey, with a capital stock of $5,000,000, has been organized for the manufacture of cells for electric storage batteries and motors for traction work, and of storage batteries for stationary and lighting purposes. It has acquired the patents on storage ba teries just issued to Messrs. Patrick Kennedy and Chas. J. Diss, of Brooklyn. These batteries are employed on the storage car on the Ninth Avenue surface road in this city, and are described on page 293 of this issue. The officers of the company are, G. C. Warner, president; Wm. H. Fletcher, vice-president; G. S. Stringfield, treasurer; C. T. Griffith, secretary; and W. M. McDougal, general manager. The company's offices are situated in the Columbia Building, 29 Broadway, New York City, and in the Fuller Building, Jersey City. Preparations are now actively going forward for the placing of the new storage cells on the market, and we understand that negotiations for the equipment of two roads, one in the East and one in Chicago, are now under way.

Liggett, Turbayne & Co., No. 54 Grand River avenue, Detroit, Mich., have equipped the Michigan Forge & Iron Company's plant with Turbayne arc lamps.

TRADE NOTES AND NOVELTIES

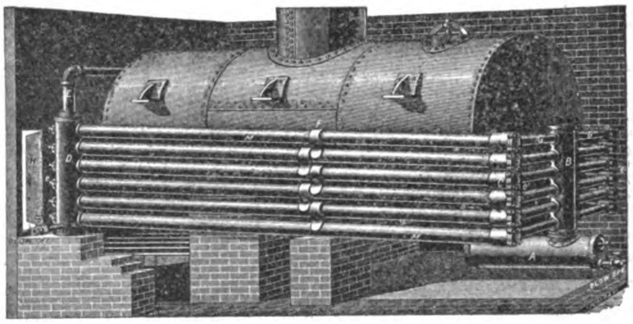
AND MECHANICAL DEPARTMENT.

People rarely, if ever, buy articles that are not advertised.

THE SLOANE IMPROVED STEAM GENERATOR AND BOILER AUXILIARY.

The accompanying engraving illustrates the latest type of steam generator design by Mr. G. W. Sloane, of 343 Manhattan avenue, Brooklyn, N. Y. Its construction is based on the same principle as the older type but one of the main features of improvement consists in placing hand holes opposite each end of every tube for facility of internal examination and cleaning out. The tubes are of the best quality American lap welded, four inches in diameter, and are inclined upwardly one-half inch to the foot, to allow of easy ingress of steam into the boiler.

These tubes are expanded in the usual manner into the drums D which are placed at the front of the boiler, one on each side, and into the heads C at the back of the boiler. Heads C are provided with heavy flanged and faced caps *e e'*, and the drums D are provided with suitable hand holes *e*, plates, guards and blow-off cocks. A 5-inch pipe O supplies the generator with water from the boiler. This flows through the mud drum A and through a 5-inch connection to drum B, thence through the pipes G (which are lap welded 2-inch internal diameter and have right and left hand threads) into heads C and tubes M through pipe E into the boiler. Pipe E varies in size from three to four inches in proportion to size of generator and boiler. Pipes G provide for any unequal expansion of tubes M. Openings are made in the front provided with doors H or an equivalent covering plate to give free access to hand holes in drums D. Openings and doors are placed in the rear wall to provide access to flanged caps *e e'*. Tubes M rest on suitable cast iron supports F.



Sloane Improved Steam Generator.

The mud drum is 12 inches in diameter and made from steel five-sixteenth inch thick, and is fitted with a hand hole, plate and guard, also with a 2-inch blow-off cock for the purpose of blowing off the scale which is carried into the drum by the circulation constantly maintained through the generator and boiler. The circulation through the mud drum being only one-sixth as rapid as in the 5-inch connections, retains the scale and sediment until the cock is opened to blow it off.

The economy both as a fuel economizer and in increased power developed is attested by many testimonials in the hands of the inventor.

THE RIES REGULATING SOCKET FROM THE STATION STANDPOINT.

The following is a copy of a letter recently received by the Ries Electric Specialty Company, of Baltimore, Md., which speaks for itself:

Office of the Dover Electric Light Company,
Dover, N. J.

The Ries Electric Specialty Company,
Baltimore, Md.

Gentlem n.—Your last shipment of regulating sockets was duly received. They meet with great favor from our customers, and we expect to have some in every building that we light. They are a great convenience to the user and are a potent factor in gaining us new customers for our lights.

Yours truly,
The Dover Electric Light Company.
D. Young,
Manager.

LARGE BUSINESS OF THE KEYSTONE ELECTRIC COMPANY.

Mr. J. W. Leech, president of the Keystone Electric Co., of Erie, Pa., favors us with the following list of motors and dynamos sold by his company during the past three months. It is a very creditable exhibit for a dull summer and shows what can be done by judiciously pushing good manufactures:

Jas. H. Link, Norfolk, Va., 10 h. p. motor to run machine-shop; D. A. Fessler, Williamsport. Pa., 1 h. p. motor to run ceiling fans; Whittier Machine Co., New York, N. Y., 5 h. p. motor (reversible) to run elevator; Birdinger, Seibert & Co., Cincinnati, Ohio, 10 h. p. motor (reversible) to run printing establishment; J. H. Link, Norfolk, Va., ¼ h. p. motor (reversible); Jamestown Electric Light Co., Jamestown, 2 h. p. motor to run printing establishment; J. Page & Son, Cohoes, N. Y., 25-light incandescent dynamo to light cotton mill; Smith Crawford, Youngstown, Ohio, 10 h. p. motor to run feed mill; Youngstown Electric Light Co., Youngstown, Ohio, 1 h. p. motor to run fans; E. E. Johnson, Chicago, Ill., 3 h. p. dynamo; E. E. Johnson, Chicago, Ill., 1 h. p. motor to run triplex pump; H. M. Sutzinger, Wilkesbarre, Pa., 2 h. p. motor; A. K. Dysher, Reading, Pa., 5 h. p. motor (reversible) to run elevator; Genessee Hotel, Buffalo, N. Y., ¼ h. p. motor to run fan; Geo. Dun, Erie, Pa., ¼ h. p. motor to run ceiling fan; M. J. O'Donnell & Co., Cleveland, Ohio, 10 h. p. motor (reversible) to run passenger elevator; Youngstown Electric Light Co., Youngstown, Ohio, 1 h. p. motor to run fans; Youngstown Electric Light Co., Youngstown, Ohio, 1 h. p. motor to run fans; Youngstown Electric Light Co., Youngstown, Ohio, 2 h. p. motor to run printing establishment; E. A. Sarran & Co., Cincinnati. Ohio, ¼ h. p. motor to run fans; E. A. Sarran & Co., Cincinnati, Ohio, 2 h. p. motor; Jas Curney, Erie, Pa., ¼ h. p. motor to run fans; Jamestown Electric Light Co., Jamestown, ½ h. p. motor to run fans; E. A. Sarran & Co., Cincinnati, Ohio, ¼ h. p. motor to run fans; E. A. Sarran & Co., Cincinnati, Ohio, 3 h. p. motor; E. A. Sarran & Co., Cincinnati, Ohio, 40-light dynamo; Youngstown Electric Light Co., Youngstown, Ohio, 1 h. p. motor to run fans; Hunt & Connell, Scranton, Pa., 1 h. p. motor to run fans; Youngstown Electric Light Co., Youngstown, Ohio, 1 h. p. motor to run fans; St. Mary's Catholic Church, Erie, Pa., 1 h. p. motor to run church organ; Marshall Bros., Pittsburgh, Pa., 5 h. p. motor (reversible) to run passenger elevator; J. H. Link, Norfolk, Va., 25-light dynamo; J. H. Link, Norfolk, Va., 12-light dynamo; J. V. Yelgerhouse, Erie, Pa., ½ h. p. motor to run optician shop; E. A. Sarran & Co., Cincinnati, Ohio, ½ h. p. motor, to run fans; E. A. Sarran & Co., Cincinnati, Ohio, 3 h. p. motor to run machine shop; Buffalo Forge Co., Columbus, Ohio, 15 h. p. motor to run ventilating fan; Buffalo Forge Co., Columbus, Ohio, 15 h. p. motor to run ventilating fan; H. Ward Leonard & Co., New York, N. Y., 3 h. p. motor to run printing establishment; H. J. Reedy Elevator Co., Cincinnati, Ohio, 7½ h. p. motor (reversible) to run elevator; H. J. Reedy Elevator Co., Cincinnati, Ohio, 15 h. p. motor (reversible) to run elevator; McCreery Ventilating Co., Toledo, Ohio, 3 h. p. motor to run ventilating fan; Heat, Light and Power Co., Muncie, Ind., ½ h. p. motor to run ventilating fan; Heat, Light and Power Co., Muncie, Ind., 1 h. p. motor to run ventilating fan; Heat, Light and Power Co., Muncie, Ind., 5 h. p. motor to run printing establishment; Heat, Light and Power Co., Muncie, Ind., 5 h. p. motor to run printing establishment; Hazeltine Woolen Mills, Warren, Pa., 40-light incandescent dynamo; M. J. O'Donnell & Co., Cleveland, Ohio, 7½ h. p. motor to run elevator; E. A. Sarran & Co., Cincinnati, Ohio, ¼ h. p. motor to run fans; Baker & Handley, Cincinnati, Ohio, 40-light dynamo; Youngstown Electric Light Co., Youngstown, Ohio, 5 h. p. motor; Rothchilds Bros., Ithaca, N. Y., 1 h. p. motor to run cash carrier; Bigelow Elec. Supply Co., Lincoln, Neb., 1 h. p. motor; Stuart & Harper, Winnipeg, Manitoba, 60-light incandescent dynamo; Dunkirk Printing Co., Dunkirk, N. Y., 7½ h. p. motor to run printing establishment; Geo. F. Patterson & Co., Baltimore, Md., ¼ h. p. motor (reversible); Buffalo Forge Co., Buffalo, N. Y., 5 h. p. motor to run ventilating fan; Kirby-Carpenter Co., Menominee, Mich., 125-light incandescent dynamo to light saw mill; F. W. Bacon & Co., Erie, Pa., 40-light incandescent dynamo to light fish house; Ames & Walker, Fargo, N. Dak., 40-light incandescent dynamo to light store.

It may be noted, in explanation of several of the items above, that the company makes a specialty of its reversible motors, without rheostats, and that it enjoys remarkable success with them.

INSULLAC.

It is a noticeable fact that the progress of practical electrical science has been so rapid that the allied chemical and mechanical arts have failed to keep the pace. Especially has this been apparent in the case of insulating compounds, shellac being the only practical agent for effective work in coil and armature winding and in the multitudinous applications where insulation resistance and waterproofing is required. The following quotation from Prof. Ayrton's "Practical Electricity," is a volume in itself. "At the present day it is very difficult to buy really good shellac, the material of commerce being very much adulterated."

The fact that shellac is manufactured abroad readily explains this condition of affairs, which is still further complicated by the adulterations of the dealers. Shellac cut in grain alcohol is much superior in resistance to solution in wood alcohol, a fact which is familiar to all electrical experts.

Some months ago the Massachusetts Chemical Company, of Boston, called the attention of their chemists to this state of affairs, believing that it should be possible to produce a varnish which could be marketed at a lower price than shellac and at the same time be of uniform quality and high resistance. That their efforts have been successful in a very great degree is demonstrated by the production of an alcohol varnish of an insulation resistance nearly four times greater than that of the best grain alcohol shellacs. The Massachusetts Electrical Engineering Company is the authority by which this superiority is established.

This varnish is aptly named "Insullac" (insulating gum). It is of a beautiful transparent amber color, but to suit the public taste the manufacturers will produce it in any desired color. Its appearance when applied, method of application and rapid drying qualities are identical with those of shellac, whose place in electrical work it may entirely supersede.

Prof. Babcock, the well known Boston chemical expert and assayer, reports that a careful analysis of the new compound shows no traces of any acids injurious to any materials to which it may be applied, or any constituent in any way injurious to the health of workmen.

The fact that "Insullac" is placed upon the market at a lower price than the poorest shellacs should at once attract the attention of all users of shellacs for electrical purposes.

THE BILLINGS & SPENCER CO.

The Billings & Spencer Co. say in regard to the past year's business and present outlook: "Our business for the present year has been very satisfactory to us and in amount has far exceeded that of last year. Our trade in Billings patent commutator bars, drop forged, of either pure Lake copper or Tobin bronze, has been constantly increasing and we are now doing a large business in this line, not only with the electrical companies manufacturing dynamos and motors, but also with the street railway companies direct, who require these goods for repairs. The sales in our machinist's tool department have been very satisfactory and constantly on the increase. In the electrical line. our linemen's hand vise, combination pliers and drop forged wrenches are meeting a large demand. We consider the outlook for the coming year to be very promising and in evidence of same would state that we are at present erecting a new factory, office and shipping department. The total length of buildings will be 208 feet by 40 feet wide, two stories and basement."

QUEEN & COMPANY.

Queen & Co. of Philadelphia report steadily increasing sales of their "Magnetic Vane" ammeters and voltmeters, which instruments meet with much favor for switchboard use. They have now been on the market long enough to show real "staying" qualities, and combine a handsome appearance with accuracy and moderate prices. An entire absence of permanent magnets and other changeable parts renders them, it is claimed, constant in indication, so that recalibration is unnecessary, unless required mechanically.

Four manufacturing concerns have adopted these instruments, and install them with both light and power plants, while numerous others use them to a considerable extent. The Queen factory is taxed to its utmost capacity and every effort is being made to keep up with the demand. Descriptive circular No. 330 will be mailed by the firm, upon request.

INTERIOR CONDUIT AND INSULATION CO.

The Interior Conduit and Insulation Co. shipped over 1,000,000 feet of their insulated tubing during the month of August last, which fact best attests the popularity of their system. Among the buildings now being wired by their system in New York City, are the American Fine Arts Building, Havemeyer Office Building, Morris Office Building, Hotel Waldorf, and the residences of C. P. Huntington, Whitelaw Reid and J. Pierpont Morgan, Jr.

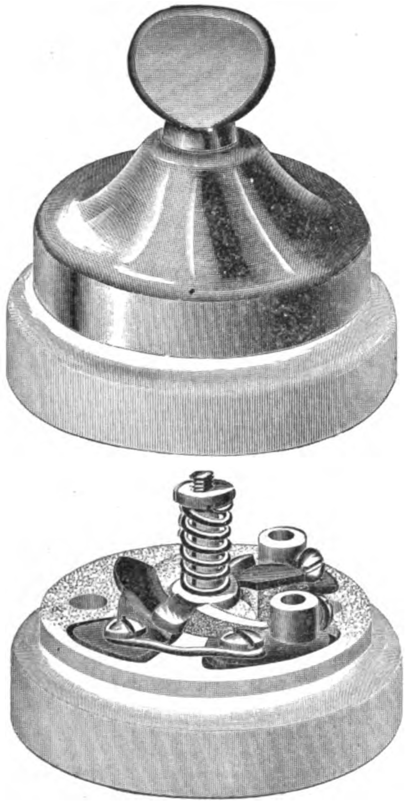
The General Electric Company has made a contract with the Merrimac Valley Street Railway Company, of Lawrence, Mass., for 15 car equipments of two each of the S. R. G. 30 type of motor. It has also contracted with the Cass Avenue Street Railway Company, of St. Louis, Mo., for 85 car equipments, each car to be equipped with two 25 h. p. motors of the W. P. type. The power plant will consist of three 800 h. p. direct-coupled dynamos.

STORAGE CARS AT A SACRIFICE.

J. C. Chamberlain & Co. of 136 Liberty street, are offering for sale the entire plant and equipment of the United Electric Traction Co., cars, engines, etc., at Marion, N. J. This equipment includes a number of railway motors of standard make, some entirely new, and others that were used but a few months; also, two 75 h. p. Straight Line Engines in perfect running order. The desire is to close out, regardless of price, this entire equipment of storage battery cars, etc., which were operated so successfully in the city of New York by the Julien Co., until litigation unfortunately brought an abrupt ending of what promised to be a most successful enterprise.

THE "IONA" SNAP SWITCH.

We illustrate in the accompanying engravings the "Iona" snap switch, which is something quite novel. It is a switch and cut-out combined, every switch being fitted with a fuse. This switch is claimed to be simpler and to have fewer parts than any other circuit breaker now made. There is nothing to wear out; it is convenient to wire, and the contacts are of soft brass, which obviates the difficulty experienced with spring clips, which lose their temper by heat and render the switch useless. The switch is made of vitrified porcelain, with nickel covers, and also in china, both plain and decorated. It is being put on the market by the Redding Electric Co., of 41 Federal street, Boston.



Figs. 1 and 2.—"Iona" Snap Switch.

THE FRINK SYSTEM FOR THE WORLD'S FAIR.

A writer in *The Collector*, a journal of art, bibliography, etc., says: "I recently mentioned the liklihood that the art section of the World's Fair at Chicago would be lighted by the Frink system of reflectors—the only system I am acquainted with which would be adequate to this important purpose. I have studied the various methods of lighting picture galleries for a number of years, and have on occasions experimented in that direction myself; and under no other system than the Frink have I found it possible to avoid those numerous drawbacks in the reflection and refraction of light by which pictures suffer so much under artificial illumination. In view of the vast preparations for the art exhibit at the Chicago Fair, therefore, it struck me as a matter of the first importance, both in justice to the exhibitors and for the benefit of the public, that the managers should give especial attention to this important feature of their galleries. I now learn that the Frink system has been finally adopted by Mr. D. H. Burnham, chief of construction of the Exposition, for use in all the seventy-eight galleries of the fine arts. The award was, moreover, made upon the tested merit of the system. Mr. James W. Ellsworth, who owns one of the finest private collections in Chicago, is a director of the Exposition, and his two private galleries have been fitted with the Frink reflectors. Their practical application, with completely successful results, led him to recommend their adoption for the department of the Exposition in which he was specially interested."

PHILADELPHIA NOTES.

The Bliss Engineering Co. have taken the agency for the District of Columbia for the Kester arc lamp for incandescent circuits, manufactured by the Kester Electric Manufacturing Co., Chicago. The Bliss Co. are wiring two halls and four large stores on G street for Mr. Geo. E. Emmons, and have just completed the wiring of Kernan's Theatre for 206 lights, which has been stated by Mr. Jas. P. Freeman, inspector of fire underwriters, to be the best-wired theatre in Washington.

The Helios Electric Co., assisted by Mr. Max Luhn, of Germany, made some very satisfactory tests, last week, with their new arc lamp, which will soon be placed upon the market. Mr. Luhn, the inventor of the Helios lamp, and who for the past nine years has acted as electrical engineer for the Helios Co., Cologne-Ehrenfeld, Germany, states that during the two years the lamp has been in use 30,000 have been sold in Germany, England and France.

Mr. C. J. Swift, general manager of the Duplex Electric Co., of Corry, Pa., was in town last week and closed a contract with Messrs. Hoopes & Townsend for a large Duplex motor and other electrical apparatus to be placed in the factory at Broad and Buttonwood streets. The Duplex Co. are running their factory night and day until an additional new factory, now under way, is ready for occupancy.

Mr. George Herbert Condict, the electrical engineer, has just returned from Europe where he has been making a study of electrical work. He has paid special attention to storage traction, in which he has had considerable experience, and he expresses himself as thoroughly satisfied in regard to the bright outlook of that industry.

The Sussex Independent, published at Deckerstown, N. J., gave a very flattering account last week of their new central station recently installed by the Heisler Electric Co., of this city. The installation has been under the supervision of Mr. John W. Carr, of Hackettstown, N. J., special agent for the Heisler Co.

W. J. Parker & Co. have just received an order for a complete steam power plant of 100 h. p., including engine, boilers and all construction work from the Elkton, Md., Electric Light and Power Co.; also a 300 h. p. Ball automatic cut-off engine from the Suburban Electric Light and Power Co., of Scranton, Pa.

NEW YORK NOTES.

The Butler Hard Rubber Company, of 33 Mercer street, this city, solicits correspondence from any one interested in storage and primary battery cells. The hard rubber cells they make are manufactured under the valuable patents granted to William Kiel, and owing to the exceeding durability and imperviousness to acids, have become recognized, it is claimed, as the best cell produced. Their construction prevents leakage and they are most satisfactory and economical. All sizes and patterns are made to order at short notice.

Truex & Vail, of the Electrical Exchange Building, 136 Liberty street, have secured the exclusive agency for the "Brilliant" high grade incandescent lamp, manufactured by the Electric Manufacturing Co., of Oconto, Wis. Although this lamp is not yet well known on the Eastern market it has gained much favor out West, and now, by the firm of Truex & Vail, will be introduced in their territory, which comprises all the New England States, New York State and Northern New Jersey.

Mr. T. A. Pamperin, the general manager of the Electric Manufacturing Company, of Oconto, Wis., makers of incandescent lamps for all systems, is now in the East and was a caller last week at the offices of The Electrical Engineer. He reports business as excellent. The company is now making lamps in all voltages from 50 to 118, and railway lamps with filament hook. Prices are maintained, as well as the quality of the product.

The Joseph Dixon Crucible Co., of Jersey City, has issued a useful little pamphlet explaining simply and clearly the value and some of the uses of pure flake graphite as a lubricant, and explaining why ordinary graphite won't do. The pamphlet should prove very interesting to mechanical and electrical engineers.

Mr. Alfred C. Boughton, a valued member of the business staff of The Electrical Engineer, was married in Brooklyn, on September 21, to Miss Ellen De Mott of that city. The happy pair are spending their honeymoon in Connecticut.

NEW ENGLAND NOTES.

Washburn and Moen Manufacturing Company, of Worcester, Mass., gave an interesting test this week of their new Salamander wire in the laboratory of the Massachusetts Electrical Engineering Company in Boston. The test was a comparative one, four different kinds of high grade rubber-insulated wires of standard manufacture being mounted on the same board, and the ends of same all joined up in series. The wires all looked equally good before the test, but afterwards there was a marked difference. The size of the wire was 14 B. & S., and 140 amperes were passed through until the copper was gradually heated to a white heat. It was observed that with the other insulated wire some took fire or burst open, or were almost consumed. The "Salamander" wire, on the contrary, remained intact, and after cooling off looked almost as good as new, as far as the insulation was concerned. The test was made to show conclusively that rubber-covered waterproof wire can be made fireproof, although up to the present no such wire has been put on the market. The copper in the "Salamander" wire is covered in the usual way with rubber insulation, which in turn is covered with a fireproof substance, which looks almost like rubber, and then braided over all and slaked with a fireproof compound. The tests proved all that Washburn & Moen have claimed for the wire, and there is no doubt but that they have filled an actual want, and that the wire will meet with an unqualified success.

Mr. J. M. Orford, who has been well known for the past eight years as the successful general manager of the Bridgeport Electric Light Company, of Bridgeport, Conn., has left that city and has accepted a position as assistant general manager of the Boston Electric Light Company, of Boston, under Mr. Fred. Gilbert, who is president and general manager. Mr. Orford has been connected with the electrical business since his early youth, and his successful career in Bridgeport has eminently fitted him for the position he now occupies, and Mr. Gilbert can well be congratulated upon securing the services of so able an electrical engineer and capable business man.

The Elektron Manufacturing Company, of Springfield, Mass., are paying special attention at present to electric elevator business in connection with several well-known elevator manufacturers. They have installed in various cities within the last few months as many as fifty of these elevators, all of which are working with satisfaction. The hoisting apparatus is driven by direct gear, the movement of the car being controlled by the movement of the motor. The Elektron Company claims that the arrangement is perfectly satisfactory and economical up to speeds of 250 feet a minute, and it will guarantee to install elevators to run at half the cost of water elevators.

The Germania Electric Company, of Boston, are introducing a line of fancy striped colored and variegated lamps, made from the finest imported French glass, and blown by Bohemian glass blowers at their factory in Marlborough. These lamps are not only in the ordinary bulbs, but are made in fancy designs representing candles, or candle flames and other attractive shapes. The colored lamps are extremely pretty, of every possible shade and design, and a peculiarly effective appearance is effected on some of the lamps by the process of matting the tinted glass.

The L. P. and D. Transmitter Company, of Montpelier, Vt., continue to have a good business in furnishing power transmitters for various purposes. Their system of transmission has proved very successful, and is attracting wide attention amongst electrical engineers. Amongst their recent sales are four to Ruben & Solomon, Pittsburgh, Pa.; one to the Du Bois Traction Company, Du Bois, Pa.; one to F. R. Dravo & Company, Pittsburgh, Pa.; one to Aneca Manufacturing Company, New London, Conn.; and one to the Arlington Mills, Lawrence, Mass.

Gillis & Gleason are successors to Albert L. Russell, of 106 Sudbury street, Boston, well known as the successor to Charles Williams, Jr. Mr. Russell has sold his business complete to the above firm, consisting of Mr. Duncan Gillis, who has for years been his confidential man, and to Mr. Thomas W. Gleason, who has for years been in the electrical business in Boston. Both gentlemen are well known to the electrical trade, and start out under good auspices, and there is no doubt but that business entrusted to them will meet with prompt and careful attention.

Mr. H. W. Somerset, late of the Mather Electric Company of Manchester, Conn., has resigned his position of superintendent for the above company to accept a similar position with the Wightman Electric Manufacturing Co. of Scranton, Pa.

WESTERN NOTES.

Paranite wire is meeting with such a growing demand that it is getting to be a case of nip and tuck with the factory to keep up with their orders. The Electric Appliance Company who are handling the Western trade are enabled to keep up with their orders with only the greatest difficulty. They state that every large shipment they receive is disposed of almost before it can be unpacked.

Mr. Wm. Taylor, Mr. Wells Goodhue and Mr. H. B. Ames who have been for many years connected with the Electrical Supply Company, have commenced business for themselves and incorporated a company under the name of Taylor, Goodhue & Ames, and will manufacture and deal in electrical material of all kinds for electric lighting, railway and power work. It is their intention to carry a large assorted stock of everything in this line so as to make prompt shipments from Chicago. For this purpose they have leased a warehouse, and for the convenience of their friends and patrons have opened a handsome suite of offices at No. 827 Monadnock Building, Chicago. Mr. Taylor is president of the new company, Mr. Goodhue, vice-president; and Mr. Ames, secretary and treasurer.

Mr. Frank E. Shepard, of the firm of Shepard & Searing, mechanical and electrical engineers, Denver, Col., is spending a month among the New England States on a trip of business and pleasure combined. Mr. Shepard was for two years U. S. Marine Boiler Inspector for New England, and the many friends he made in the service will be more than glad to welcome him back to the "old stamping ground." He will visit many of the new electric lighting and power plants, and make a special study of the L. P. & D. system of transmission at the Concord Gas Company's plant, Concord, N. H. Mr. Shepard will be in Boston on the 5th of October, in order to be present at his brother's wedding.

The Electric Appliance Company are exhibiting a sample of the Schuttler ratchet track drill in their store at 242 Madison street Chicago. The rapidity and ease with which it puts a hole through a section of rail is really marvelous, and it will undoubtedly be only a matter of time before it will be generally used for street railway work. The Electric Appliance Company have in preparation a modified form of the drill which will be known as the "shop drill." This is designed for general shop work as well as a track drill, and will be a very desirable tool around every electric light station and street railway plant.

Mrs. George Brown, wife of the general manager of the Pullman Palace Car Company, and mother of Charles E. Brown of the Central Electric Company, died at Gloucester, Mass., on the 12th inst., as the result of injuries received four weeks ago. She was then driving with some friends, when the carriage was overturned and her spine hurt. Mr. Brown has the sympathy of his many friends in his bereavement.

Mr. George Cutter, the electrical specialist of the West, is just moving into larger quarters in Chicago, and his address hereafter will be 329 the Rookery, that city. He will continue to handle a number of valuable specialties, and will also be heard to make some casual remarks about "Simplex."

Wm. Hood & Co., manager of the Chicago office of the Electric Manufacturing Company, makers of the "Brilliant" incandescent lamps, reports the receipt of numerous large orders, and states that the lamps are giving perfect satisfaction, as all those who have used them are ordering more.

Mr. H. E. Seemuller, formerly connected with the advertising department of the Yale & Towne Manufacturing Company, recently accepted a position with Henry R. Worthington at their Chicago branch.

Clark & Marshall, No. 4'3 The Rookery, have secured the Western agency for the Boston incandescent lamp, manufactured by the Boston Incandescent Lamp Co., of Boston Mass.

The Central Electric Company report large sales of triple and double braid weatherproof wire, besides a steady demand for Okonite wire, cord and Manson tape.

CANADIAN NOTES.

The Brantford Electric and Power Company, Limited, will apply for incorporation, with a capital of $150,000. Its object is to acquire and develop the water-power of the Grand River, at Brantford, Ont., of which, it is estimated, a minimum of 650 h. p. will be available for conversion into electricity and distribution for light and power. This company will also acquire and operate the plant and property of the Brantford Electric Lighting Company, whose present arc and incandescent lighting systems will be extended.

Mr. T. Ahearn, of Ottawa, has disposed of the United States patents on his electrical car heaters to the Railway Equipment Company, of Chicago. These heaters were used on the cars of the Ottawa Electric Street Railway during the past winter with the greatest success. The cars were comfortably warmed on the coldest days when the temperature was below zero, which the other heaters used had failed to do.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.***

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THE GENESIS OF THE MODERN DYNAMO: ANTONIO PACINOTTI.—III.

BY

Franklin Leonard Pope

Pacinotti at the Age of 23.

Having completed his service in the army, Pacinotti returned to Pisa, and for a time was so fully occupied in preparing for his approaching University examinations, as to render necessary the intermission, for the time, of the course of experimentation upon which he had entered with such promising results. In the spring of 1860, he resumed his investigations and it was at this time that with the assistance of Joseph Poggiali, the mechanician of the Physico-Technological Cabinet of the University of Pisa, he constructed the now well-known little machine, which in later years, was destined to confer such high distinction upon its fortunate designer. After such progress had been made in the construction of this apparatus as to permit of the making of tests, the following memorandum was entered in the notebook of projects of 1858:

> April, 1860. The electromagnetic machine of which the first notions are found hereinabove recorded, has been constructed by me as a small model * * * * * * This machine has a single stationary electromagnet. It acts well as a magneto-electric machine, since it gives a continuous current always in one direction and very intense [strong].

Upon a loose sheet of paper, Dr. Pacinotti has fortunately preserved a number of memoranda, noted down at the time, of the results of these tests. Among these results are determinations of the mechanical work obtained by means of the machine, from one, two, three and four small Bunsen cells under various conditions, as for example, (1) when the same current traversed both the armature and the field magnet; (2) when the current from three cells traversed the armature alone; (3) when the current from three cells traversed the armature, and that from two additional cells the field magnets. These measurements are dated June 22, 1860. The next day, June 23, the order of the experiments was reversed, and on the same sheet as the preceding are found recorded a number of measurements of the value of the continuous direct currents obtained from the machine itself, by rotating the armature at different speeds, as well as by varying the angular position of the contact springs upon the commutator.

In September of the same year, Pacinotti prepared a thesis, which although never as yet published, was in some respects more complete in detail than the article published five years later in *Il Nuovo Cimento*. In this paper, the author sought to enumerate the advantages which he believed his apparatus to possess over those previously known, and expressed a desire that an opportunity might be found for it to undergo competitive tests, in comparison with other known machines.

With a view of making such tests, Pacinotti obtained, after his return to Pisa at the beginning of the scholastic year of 1860-61, a small model of Froment's electromagnetic motor, a well-known piece of laboratory apparatus, and at once undertook to make careful determinations, not only of the mechanical work actually produced, taking friction into account, but of the differences in the value of the current when the machine was at rest and when it was in motion, and of the internal resistance between the terminals of the machine under these different conditions. The notes made at the time of some of these quantitative results have been preserved. Subsequently, some of these observations were reduced according to the theory of Jacobi, as given in Note D of De la Rive's *Traité d'Electricité*, showing for the machine of Pacinotti a higher economic efficiency than for that of Froment.

An interesting unpublished manuscript of this date discusses at a considerable length the general theory of electromagnetic motors, in which the author has attempted to more completely develop the well-known theory of M. Jacobi. The note referred to in the treatise of M. De la Rive contains also a communication from M. Soret, in which it is pointed out that the currents of induction developed in the stationary helices at the instant of closing of the circuit constitute the chief obstacle to the development of an augmented current in proportion to the increase in the power applied to effect the rotation of the machine when used as a generator. This observation of M. Soret led Pacinotti, by a logical course of reasoning, to anticipate results of value from the system of connections which he had originated, in which the construction of the commutator was such as to occasion no interruption of the current, and which tended therefore to avoid most of the inconveniences likely to arise from induced currents.

Just as Pacinotti had reached this most interesting stage in the progress of his investigations, he received the unexpected honor of a nomination for the Assistant Professorship of Astronomy in the Royal Museum of Florence. The offer was too flattering a one to a young man just entering upon a promising career, not to be accepted, and although for many years the youthful philosopher did not forbear to cherish the idea of extending his investigations, by the construction of a machine of much larger dimensions, yet he found his time was so fully taken up by the duties of his new position that he was unable to do so. At length therefore he wisely determined to place on record an account of his work so far as it had gone, which he did by preparing and publishing the article heretofore reproduced, in *Il Nuovo Cimento.*

A BIOGRAPHICAL SKETCH OF THE KHOTINSKY ACCUMULATOR.—IV.

BY

Capt. A. de Khotinsky

For my living I had to seek other employment, and I found it with a London firm in joining small pieces of amber and giving them a certain form, which process I devised in the laboratory of my friend, Mr. L. Warnerke. After this work was completed, Mr. Warnerke placed at my disposal, in the most unselfish and friendly way, his laboratory and workshops. There I occupied myself in making filaments for high potential lamps.

In June, 1883, I became acquainted with Mr. La Grange, of Rotterdam, who heartily interested himself in my accumulators and opened bright prospects to find capital in Holland for carrying on the business there. At his request, I built in Charlton a battery, and went with it, in August, 1883, to Rotterdam. After several public experiments with this battery, and on account of the recommendations of Mr. Preece in London, a stock company, called the Electriciteits Maatschappy, System de Khotinsky, of Rotterdam, was formed. After returning from Paris to London I had—following Mr. Preece's advice—taken out a patent on the accumulator.

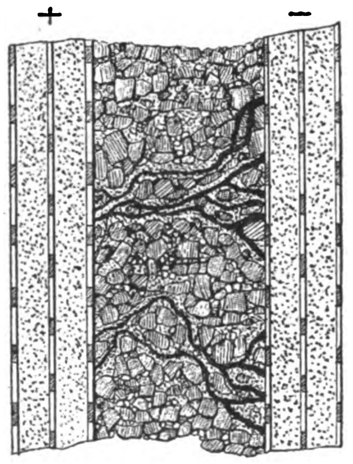


FIG. 13.

The battery with which I experimented in Holland was built according to the same patent, with this improvement, that the space between the positive and negative plates was filled with granulated pumice stone, which prevented the swelling up of the positive plate.

The tendency of the positive plates to swell up and, by contact with the negative, to cause a short-circuit, I had already noticed in my experiments in England. To gather more experience by experiments on a larger scale, the company ordered me to light, by accumulators, two blocks of houses, chiefly offices of merchants. It required about 250 glow lamps of 16 c. p. each. I built, therefore, accumulators exactly like my experimental battery, only larger, and instead of hard rubber boxes I used wooden ones. The batteries were set up in two small boats for the purpose of charging the accumulators during the day from the factory, situated on an island in the river Maas, so that they would be ready for delivery in the evening at the block stations in the harbor. For this reason it was necessary that the batteries should be arranged as transportable accumulators. The experiments were continued during eight months and gave me sufficient opportunity to detect the deficiencies which yet adhered to their construction.

The first fault I observed was that when the battery had been for some time on open circuit internal discharge occurred in some cells. I examined, therefore, the plates of these cells and found them in perfectly good condition. I fitted them out anew, set them in action, and then the internal discharge apparently discontinued and the battery worked normally. Two weeks later the existence of internal discharge again appeared in other cells. I observed thereby that during the charging of the cells in which the inner discharge occurred the boxes became hot, not over the whole surface, but only in certain parts, and in most cases at the lower part of the box on the edge side of the electrodes. This circumstance convinced me that in these places an imperfect inner short-circuit existed. In order to find the cause of the short-circuit I found it necessary to break the boxes without touching the plates, for if I were to take out the plates I must first remove the pumice stone and thus destroy the very sensitive places of the short-circuit, which I wished to see.

When the box of the self-discharged cell was opened in this way I found on the top of the warm spot, between the granulated pumice stone, ramifications of fine powder the color of which was yellowish brown at the positive plate and passing to metallic gray at the negative, having the appearance shown in Fig. 13. On examining other cells immediately after the charging I found the same ramifications, but their color was entirely metallic gray. In both cases the root of the ramifications started at the negative plates from the outer perforation of the enveloping sheath. These ramifications always formed themselves in places where the finest powder of the pumice stone was situated.

In searching for the inner short-circuit, I observed that the positive plates commenced to become ruined at the lowest parts while the upper parts were perfectly sound and good. I opened the electrode and found that the lower part of the sheathing had completely oxidized, while the inner plate, even at the lower end, showed only one-tenth mm. of oxidization. The whole quantity of spongy lead was changed into peroxide and appeared in the form of a free powder which had fallen from the carrier by its own weight and become deposited at the lowest end of the plate in compact masses.

I noticed that the destruction of the positive electrode began at the lower part on account of the higher specific gravity of the acid at that point, for on first charging and discharging a cell I noticed that the acid is heavier at the lowest point. This is caused by the fact that in discharging the active mass the electrode combines with pure sulphuric acid which becomes free again at the next charging and sinks to the bottom along the outside of the electrode.

In experimenting with one cell filled with well-mixed 10 per cent. solution of acid, after a few successive charges and discharges, I found that the specific gravity of the acid in a charged cell changed so that in the upper part 2½ per cent. and at the bottom 30 per cent. of acid was found in solution. To obtain successful results from these experiments great care must be taken not to overcharge, because the rising of the developing gas will artificially mix the acid.

From this confirmed fact it follows that the lower part of a plate must be sooner destroyed by extra work imposed on it by the stronger acid, and by the same agency in the lower part the internal resistance is reduced while in the upper part of the plate, by reason of the lighter acid, the opposite occurs and the internal resistance is therefore increased.

MR. C. G. YOUNG, late superintendent of the Mt. Morris Electric Light Co. of this city, has resigned his position and has associated himself with the firm of J. G. White & Co., the electric railway contractors. He will devote himself to the new field of work and is already busy on construction work in Baltimore.

THE POOL MOTOR AND DYNAMO.

AMONG the dynamo-electric machines of recent design possessing novel features is that of Mr. J. G. Pool, electrician of the Hubinger & Pool Co., of New Haven, Conn.

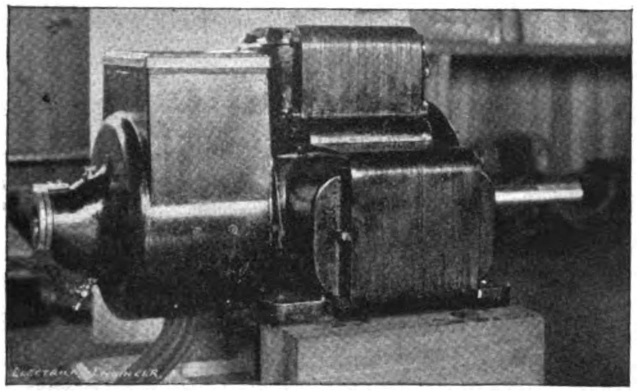


FIG. 1.—THE POOL MULTIPOLAR MOTOR.

The machine was designed especially for the purpose of operating electric yachts, but is also equally applicable to mining work, portable hoisting and pumping machinery, fire engines, and for all purposes where a motor may be required for service in wet or damp places or where exposed to the weather. It goes without saying, however, that it may also be used in all places where a motor or dynamo may be required.

The accompanying engraving, Fig. 1, shows the machine complete, and Fig. 2 shows it turned 90 degrees from its proper vertical position, exhibiting the commutator and brushes, the cover of the box enclosing the latter being removed. In practice this box is closed by a glass plate so as to show at all times the condition of the commutator and brushes. Fig. 3 shows the end of the armature case removed and the end of the armature as it appears in place in the field, illustrating the proportional size of armature as compared with the other dimensions of the machine, as well as the method of mounting the armature on the shaft.

The motor has been designed with special regard to efficiency and durability, and the protection of all wires and working parts from injury, either by moisture or otherwise. The field magnets are iron clad, the exciting coils being entirely surrounded by iron, the magnetic circuit being exceedingly short and without break. The field magnets are laminated, being formed of alternate layers of the best charcoal iron and paper similar to the construction used in armatures. Foucault currents are thereby entirely avoided and the machine runs cool even when overloaded.

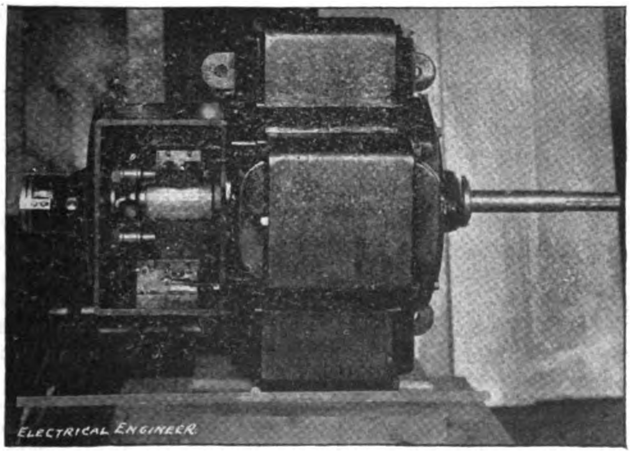


FIG. 2.—THE POOL MULTIPOLAR MOTOR.

The engraving Fig. 4 shows the shape of the sheet iron stamping of which the field magnets are constructed, one die answering for all of the eight positions in which it is placed and producing a magnet which when put together is as stiff and rigid as a solid piece. An inspection of Fig. 5 will readily show how this is accomplished. A layer of pieces such as is shown in Fig. 4 are first placed together on a flat surface and held in position by rods or bolts passed through the holes, the junctions of this layer being represented by the dotted lines B, Fig. 5; the next layer of plates is then reversed, the junctions appearing at the solid lines E. This alternation of layers is continued until the proper thickness for the field is attained, the projections D interlocking throughout, thus producing a solid, laminated field without break in the magnetic circuit and at a minimum of cost.

The field coils are wound on spools and slipped in place and secured there by clips not shown. The magnetic circuit being very short the amount of wire required to excite the fields is very small, being in this machine only 35 pounds. The magnetic circuit is shown in dotted lines through one portion of the field, which constitutes eight poles, alternately north and south.

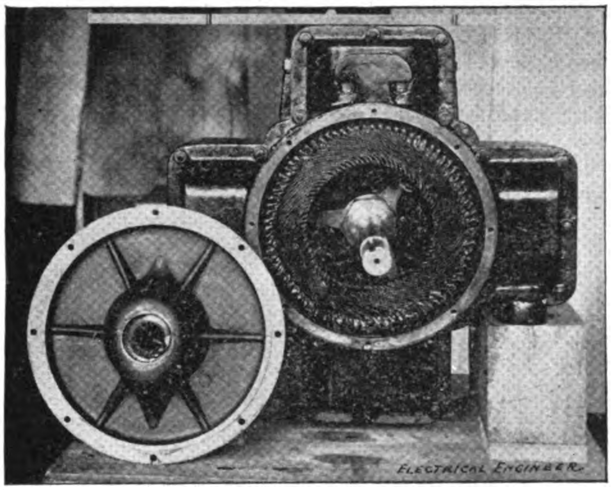


FIG. 3.—THE POOL MULTIPOLAR MOTOR.

The winding of the armature is such that the actions which take place are precisely the same as those which occur in the best style of cylinder armature when placed in a bi-polar field, each wire being carried in alternate directions under each pole of the field before being carried to the next bar of the commutator. Each wire is of exactly the same length as every other and occupies an exactly similar position in the field.

The various wires forming the winding are connected in series without any cross-connections of either wire or commutator and only two brushes are required, set at a distance apart on the commutator equal to the angle formed by two adjacent neutral points of the field. This method of winding obviates all of the objections which have been raised against the multipolar type of machine, while all of the advantages of this method of construction are retained. In the armature of the machine shown each pole of the field generates only a fraction of the electromotive force, such fraction being represented by the number of poles in the field, the electromotive forces generated being joined in series by the peculiar method adopted in winding without cross-connections. Each portion of each wire is equally influenced by each of the poles of the field at each instant, producing a complete electrical balance independent of the strength of any individual pole of the field. The armature is of special design, the wire being wound in grooves and entirely imbedded beneath the surface, thereby reducing the gap between the armature and field poles to the smallest possible amount. The resistance of the armature is $\frac{12}{100}$ ohm.

The machine runs with absolutely no spark from full load to no load and vice versa; the direction of motion may also be reversed and the machine operated throughout its full range and without moving the brushes and without spark. The brushes may be moved through an angle which is almost equal to two adjacent neutral points of the field without causing a spark.

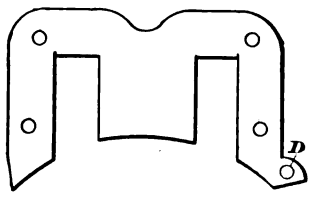
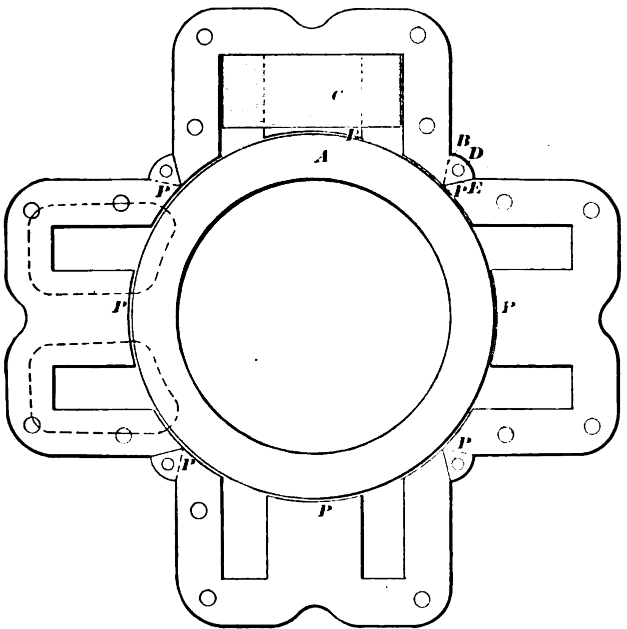


FIG. 4.—FIELD MAGNET STAMPING.

The machine is entirely encased in iron and may, if required, be placed and operated in the open air without protection in any weather or climate, thus affording a machine suitable for many purposes for which the electric motor has not heretofore been adapted.

The machine is self-oiling throughout and requires no attention. The centre of gravity is very low and it is peculiarly adapted to the operation of electric yachts for which it was originally designed, its shape allowing it to be placed low (as it nearly conforms to the shape of the hull) and to be coupled to the propeller direct. The machine is designed for an electromotive force of 120 volts.



Elec. Engineer

FIG. 5.—FIELD MAGNET OF POOL MOTOR.

A NEW MAGNETIC ROCK.

A GREEN rock, strongly resembling serpentine in appearance, has recently been discovered in large quantities at Borzanasca, in Liguria. The most curious feature about it is that it possesses distinct polar magnetism. The rock has been analyzed, and found to consist of silica, 39.84; alumina, 3.08; iron oxides, 7.07; magnesia, 36.63; lime, 1.14; water, 12.86. The microscope reveals the presence of bastite and small crystals of diopside, diallage and chrysotile, but the magnetic properties are difficult to account for.

TWISTING MAGNETISM?

BY

Chas. Steinmetz.

IN a recent issue of THE ELECTRICAL ENGINEER, I read an account of a unipolar machine, under the above heading, and regarding which I should like to make some remarks.

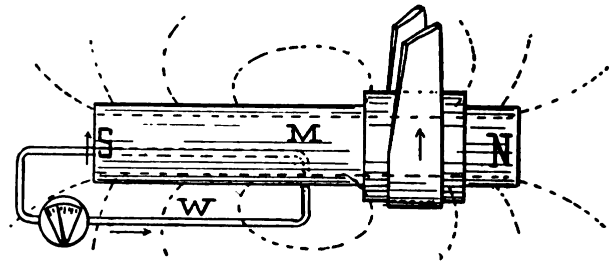


FIG. 1.

While the machine shown in Fig. 1[1] will give a small E. M. F., the machine in Fig. 3 *cannot* give any trace of E. M. F. not because the magnetism does not twist, but because the magnetic field of a magnet does *not revolve* when the magnet is revolved, but remains *stationary*, uninfluenced by any revolution of the magnet or the exciting helix, which, as is known, is a magnet even without iron. Consequently, in Fig. 1, in the outside conductor W, no E. M. F. is induced by the revolving magnet; but the seat of the observed E. M. F. is the inside conductor, the magnet M S itself, which in each revolution intersects all the lines of magnetic force once.

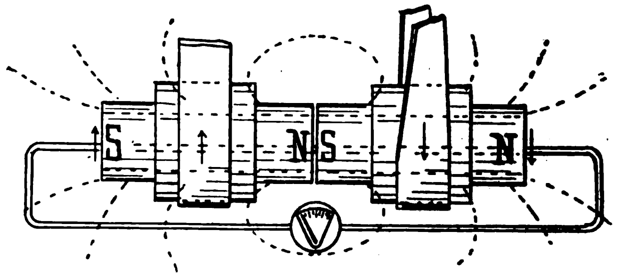


FIG. 3.

Now consider Fig. 3. The outside conductor is dead again, being stationary in a stationary magnetic field. But the inside conductor in either of the two magnets intersects every line of magnetic force twice in opposite directions, and consequently is the seat of two equal and opposite E. M. F.'s, which completely neutralize each other, so that the result is nil, as observed.

We would, however, get a current from the arrangement in Fig. 3, if the two magnets at their adjoining faces were connected not inside, but on the outside, by a conducting sleeve bearing upon both magnets; because in this case the lines of magnetic force passing through the gap between the magnets would be intersected twice per revolution by the conductors forming the revolving connections from the outside ends of the magnets to the connecting sleeve.

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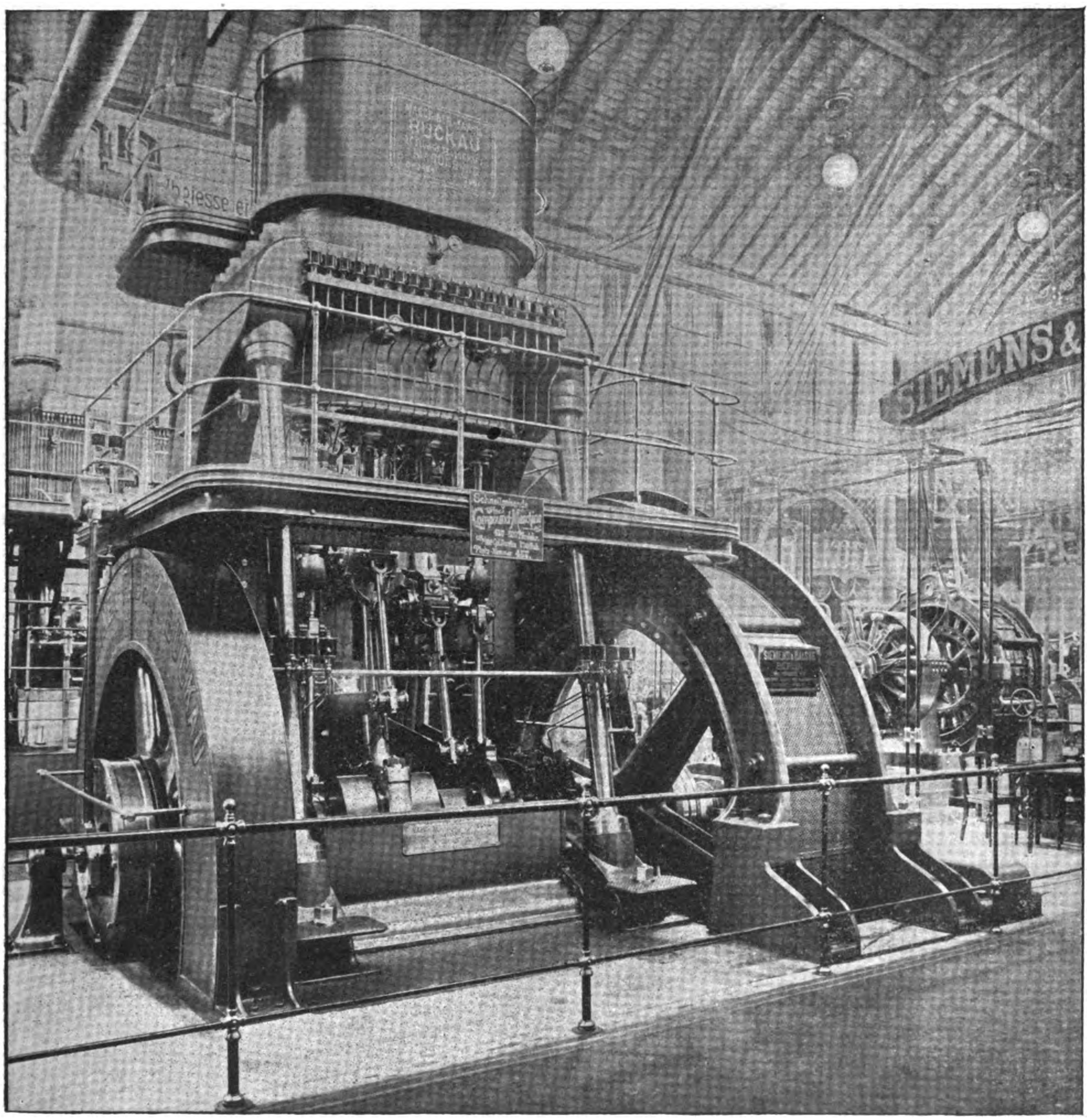
[1] Figs. 1 and 3 are reproduced from our issue of Sept. 14.—EDS. ELECTRICAL ENGINEER.

SIEMENS & HALSKE DIRECT-DRIVEN CONTINUOUS CURRENT AND ALTERNATING GENERATORS.

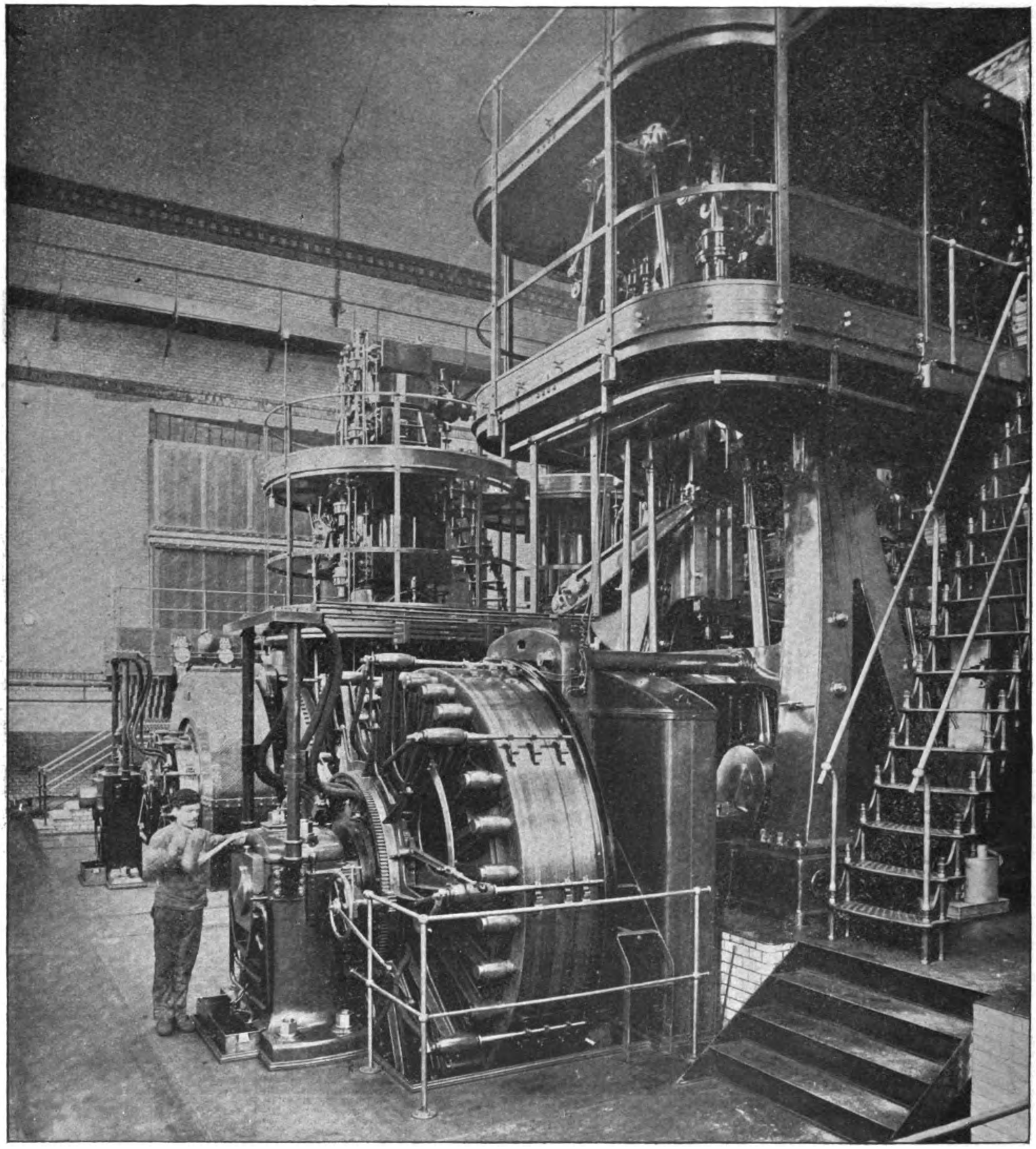
SIEMENS & HALSKE, believing that a large dynamo, coupled directly to the steam engine shaft, running at comparatively low rates of speed, thereby saving the expense of belting, with its corresponding loss of power through friction, slipping, etc., was bound to be the machine of the future, turned their attention to the designing and construction of such machines, and have gone from 500 h. p. to 1,000 h. p., thence to 1,500 h. p. and now 2,000 h. p., a size about three times as large as built so far in this country.

The mechanical, electrical and financial results achieved by the Siemens & Halske large dynamos fully warrant the belief of those who advocate such large machines. The accompanying illustration shows one of the 1,000 h. p. alternating machines coupled direct to a 1,000 h. p. Collman engine. This machine develops 700,000 watts, 2,000 volts and 350 amperes. This machine has 60 poles. The armature is stationary. The field magnet ring consists of 60 bobbins, rotating inside the armature, which has the same number of coils. The outside diameter of the rotating field magnets, is 12.2 feet; the armature, 15.1; number of revolutions, 100 per minute, so that it has 6,000 alternations per minute. The field magnets are excited by a direct current, which is brought from an exciter machine. Every coil is insulated with hard rubber from all metallic connections, and the stationary armature, such as is used in this type of machine, enables the makers to provide much better insulation than when the armature itself revolves.



THE SIEMENS AND HALSKE DIRECT DRIVEN ALTERNATING GENERATOR OF 1,000 H. P.

The other illustration shows the direct current dynamo. It is of the inside pole ring type, which class has from four to twelve poles. They are placed in the form of a star inside the rotating armature. The brushes, which are always of the same number as the field magnets, take off the current from the outside of the armature winding. The armature itself consists of an iron ring wound with copper segments. The special machine illustrated has ten poles and is designed for an output of 746,000 watts. This machine can be built without special commutator for from 100 to 700 volts, and can be used for lighting and power. The drop of potential in the armature is only 2 per cent. with maximum load. For exciting the field magnets, only ½ per cent. is required. Therefore, the electrical efficiency of this machine is about 96½ per cent. It is shunt-wound and has a peripheral speed of 50 feet per second.



THE SIEMENS & HALSKE DIRECT DRIVEN CONTINUOUS CURRENT GENERATOR, INSIDE POLE RING TYPE.

The works of the Siemens & Halske Electric Company, of America, are located in Chicago. They receive all drawings from Berlin, and will duplicate the construction that has resulted from the vast experience gained by Siemens & Halske during the half century of their existence.

THE AHEARN electric cooking apparatus, which was recently used at the Windsor Hotel, Ottawa, Canada, in cooking a whole dinner, is now on exhibition at the Central Canada Fair, Ottawa, where R. E. Jamieson, baker and confectioner, employs it in baking cake, bread, etc. We have just received from the fair a tea cake beautifully cooked in the Ahearn electric oven. Truly electricity "takes the cake" now-a-days.

THE LEONARD THREE-WIRE PLANT AT CHARLESTOWN, W. VA.

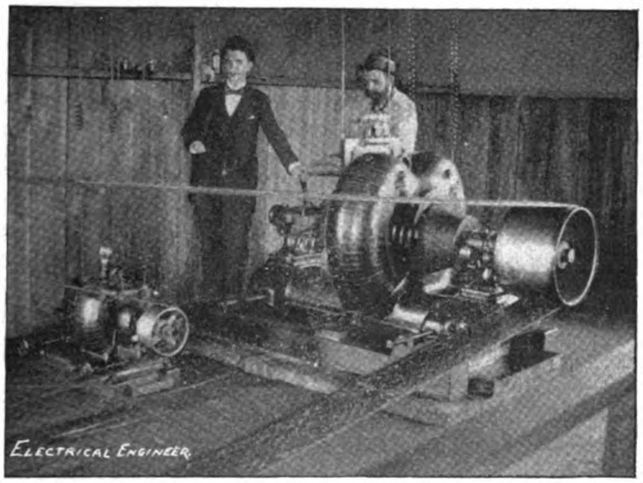
The Leonard three-wire system is identical in every way with the familiar Edison three-wire system, from the switchboard to the lamps inclusive. The first cost, efficiency and method of handling the system of conductors are exactly the same in every respect in the two systems. The difference between the two lies in the source of electric energy. In the Edison system there is a divided source of electrical energy, with the neutral wire connected at the point of division. That is, in the Edison system two dynamos, identical in size and voltage, are connected in series with each other and the neutral wire of the three-wire system is connected between them.

In ordinary practice, for incandescent lighting each dynamo produces about 125 volts. In the Leonard three-wire system (see diagram) there is one dynamo of 250 volts, which is connected to the outside wires of the three-wire system, and this dynamo is the source of electric energy and the neutral wire is not connected to it at all. But a very small compensating dynamo of 125 volts, and, perhaps, 20 amperes, is connected between the neutral and one of the outside wires and this compensating dynamo is connected by a belt to the same motive power that drives the large dynamo.

This compensating dynamo operates sometimes as a generator and at other times as a motor, depending upon the preponderance of load on one side or other of the system. The field of this small machine is wound for 250 volts and is excited by a derived circuit from the large dynamo.

The large dynamo is shunt-wound and self-exciting, hence an adjustment of its field rheostat not only increases the E. M. F. of the large dynamo, but also the E. M. F. of the small compensating dynamo in the same proportion, so that the E. M. F. of both sides of the system is increased or decreased at will by the movement of the one rheostat in the field of the large dynamo, thus considerably simplifying the regulation of E. M. F. upon the system.

The number of dynamos being reduced by one-half, the care of bearings, brushes, etc., is greatly reduced, as also the chances of burn-outs and other accidents.



The Leonard Three-Wire Plant at Charlestown, W. Va.

The first central station ever put in operation on the Leonard three-wire system was at Charlestown, W. Va., a town of about 3,000 inhabitants.

A well-known electrical company had taken a contract to establish a continuous current plant. The plant was to be one of 750 lights. The distances were considerable, the station being located entirely outside of the town at a distance of three-quarters of a mile from the nearest lighting. The cost of copper by the two-wire system would have been about $8,000. By the use of the Leonard three-wire system the cost of copper was reduced to $2,500, a net saving of $5,500, or over $7 per lamp. In this case, by the Leonard three-wire system the cost of copper was a little over $3 per lamp. In the average case, when the distance to the lighting is less, the cost of copper will range from $1 to $2.50 per 16 c. p. lamp.

In the picture given herewith, showing the plant at Charlestown, W. Va., operated by the City Electric Light Company, the comparative size of the two dynamos is clearly shown, the larger one being 40 K. W. and the small one 2½ K. W. In the case of larger plants, the difference between the capacity of the main dynamos and the compensating dynamos becomes still more marked.

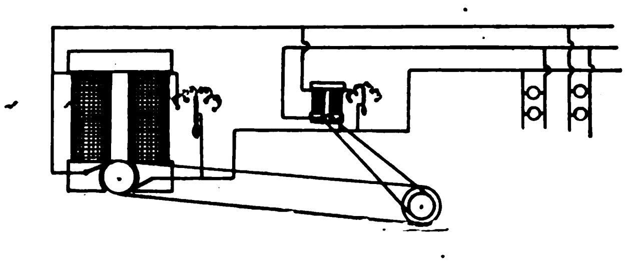


Diagram of Leonard Three-Wire System.

The average cost of a central station of 1,000 lights (16 c. p., 50 watts, 110 volts) on the Leonard three-wire system, we are informed, would be about as follows:

Dynamos, instruments and switchboard	$2,000
Copper for three-wire system	2,500
Pole line and construction for same	1,000
Services and wiring for 1,000 16 c. p. lamps, with lamps and sockets	2,500
100 h. p. steam plant	4,500
Lot and building	2,500
	$15,000

The revenue from such a plant, properly operated, in a town of about 4,000 inhabitants, would be about $750 to $800 per month, and the operating expenses about $450 to $550 per month, varying with the local conditions.

A CONSOLIDATION OF BRASS MANUFACTURERS.

Thomas B. Kent, vice-president of the Holmes, Booth & Hayden Manufacturing Company, in speaking of the report of a proposed brass trust, said last week that no "trust" would be formed. "There have been several meetings of the brass manufacturers who have plants in the Connecticut valley, with a view towards consolidation, but there is neither talk nor thought of a trust. No plan has yet been fixed upon, but I hope that by the beginning of next year the consolidation will be effected. It would be an excellent thing for all concerned, and the expenses of manufacture would be lessened greatly. Where we now have five New York offices, under consolidation one would suffice. We now spend about $50,000 a year each in advertising. That amount would be sufficient for us all if we consolidated, and the reduction in all other branches, save that of actual manufacture, would be the same. The gross output of the companies would not be reduced, and instead we would try to secure more foreign trade. There would be no competition, but the price to consumers would be lower if any change were made. There will be no stock for sale; it will be allotted to each manufacturer in a direct ratio to the actual value of the plant. Nothing is settled yet, however, and our plans may come to nothing after all."

Among the companies interested in the proposed consolidation are the Scovill Manufacturing Company of Waterbury, the Holmes, Booth & Hayden Company of Waterbury, Plume & Atwood of Waterbury, Benedict & Burnham of Waterbury, Waterbury Brass Company, Ansonia Brass and Copper Company of Ansonia, and the Coe Brass Company of Torrington. The capitalization will probably be from $12,000,000 to $15,000,000.

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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VOL. XIV. NEW YORK, OCTOBER 5, 1892. No. 231.

Think of a city operated by science, as every city might be now, without one of the wretched animals tamed by the savage man! A city without a horse, where electricity brought every man and everything silently to the door.—William Dean Howells.

ROOM FOR ALL IN ELECTRIC TRACTION.

PROBABLY at no previous time in the history of electric railroading in this country has the question of the methods of traction occupied so prominent a place in the thoughts not only of electrical engineers, but of the public as well, as at the present moment. The trolley is well established, and appears to be destined to a long career of usefulness; still it would not be risking too much to hazard the opinion that both the storage battery and underground conduit systems will find more or less application in the not distant future. The recent communication by "Gautherot," which appeared in our columns, pointed out very forcibly the reasons why storage battery traction has not been, thus far, successfully carried out in this country. The word "successful" here used refers particularly to the commercial aspect, rather than to the electrical, for that storage cars can be operated needs no further demonstration at this late day. On this subject Mr. G. Herbert Condict, whose experience in this field has extended over a long period, strongly supports the position taken by "Gautherot," and he also points out another fact which is frequently lost sight of by those undertaking storage traction work, namely, the selection of roads for experimentation which are essentially unsuitable to this class of traffic. While it is true that a successful system must eventually be one capable of being placed on any line, it is surely overtaxing a young and struggling system to break it in, as it were, on roads with difficult grades, bad tracks and heavy traffic. What has just been said is also applicable, for the most part, to underground traction. The failures which have attended attempts in this direction, so far, in this country are, we believe, traceable more to financial than to any other reasons; but the success already obtained abroad, and, we may add, even in experimental instances in this country, leaves no room for doubt that we shall soon see more of this system in actual work. We believe that the history of electric traction in the future will be a repetition, in a way, of that of electric lighting.

Having thus placed ourselves on record, we may, perhaps, be permitted to congratulate the Metropolitan Traction Company of this city on obtaining permission that will enable them to run trolley cars into the city proper under the Elevated Roads and elsewhere. This is a great gain and a long step forward in rapid transit work, and we know that in the city, as in the suburbs, the trolley will be found by the public to be a most useful addition to the facilities of travel. The public is ready for it. We are told by the press that the public is intense in its opposition to it. This is wantonly and absolutely untrue. A close perusal of all the city papers for the past six months has failed to show us the slightest evidence of an antagonistic public sentiment outside their own editorial pages. But if there is such a public feeling, why does it not manifest itself up in the Annexed District, where the Union Railway Company is now running trolley cars on several lines? Last Sunday we found it impossible to get a foothold on the cars, so jammed were they with jolly and enthusiastic crowds of the plain commonsense New Yorkers, who never yet allowed themselves to be prejudiced against a good thing simply because it was new.

STORAGE BATTERY STATIONS.

IN commenting on the views expressed through these columns by a well-known engineer recently returned from a trip of inspection through Europe, the London *Electrical Review* remarks that his opinions must have been formed upon too narrow a basis and upon too hurried an examination. This is by no means the case. Our communicant is known everywhere as an able and most careful engineer. He went abroad wishing to be convinced, and came back believing that in stations with a large day load, the battery had no chance, so far as America is concerned. We gave currency to his views because to some extent they controverted our own, and because we wish to see the matter threshed out. We are still decidedly of the opinion that a great many of our small stations need battery equipments for their hours of light load, and we hope to see the plan adopted. But we cannot quite reason ourselves into the position that a light load is desirable, because it gives you a chance to use storage batteries. The best station business is that which has a good load diagram all the day through, all the year round. A summer hotel may do a very paying business for three months in the year—our experience as a guest runs that way—but after all it is not as profitable and satisfactory as a city hotel which has its rooms full from January to December. In the same way we can understand the conditions under which a station six hours out of the twenty-four is earning well, but simply exists the other eighteen by the aid of the batteries. It must be evident that a station with a heavy day load for light and power is in better shape by being able to get along without the batteries. And this is true without any reflection on batteries as a valuable adjunct in certain places.

ELECTRIC RAILWAY DEPARTMENT.

A PRACTICAL CONDUIT TROLLEY SYSTEM.

BY

RJ Hewett

In working out this system the writer has been guided mainly by the conditions and requirements of practical conduit work, an outline of which has been given.[1] Fig. 1 is a cross-section and Fig. 2, a longitudinal section showing the conduit trolley device and truck.

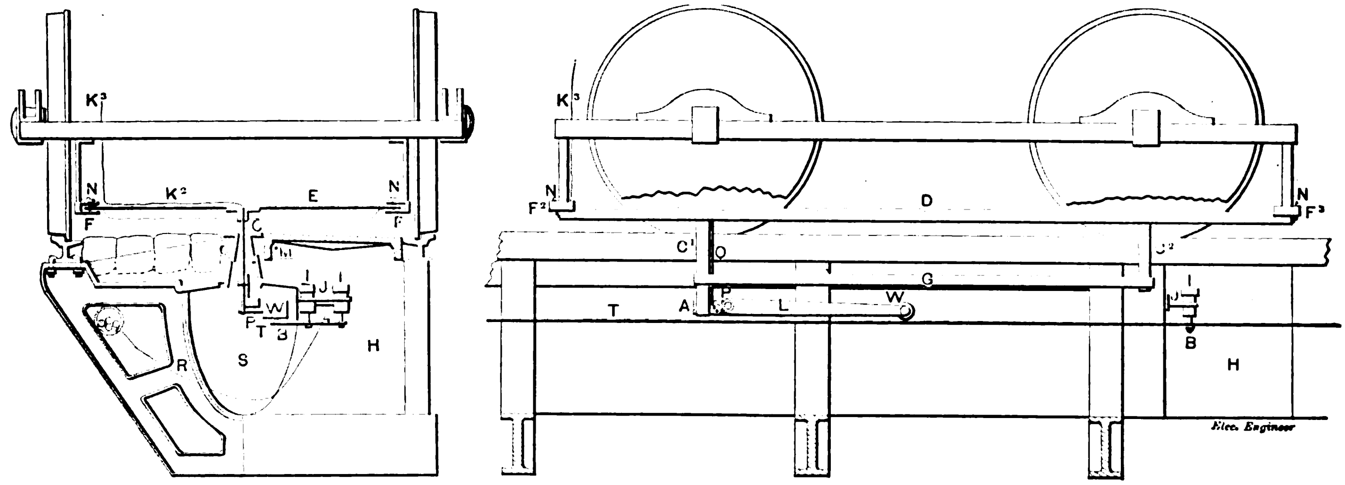
The conduit and permanent way are patterned after regular cable conduit work and constructed in a similar manner. The conduit S, Fig. 1, is 29½ inches deep by 18 inches wide. The roofof the conduit is formed of wrought iron angle plates, U U, resting on overhanging arms of the yokes. On top of the angle plates are placed the sand bed and paving blocks .

A feed-wire conduit composed of tubes of suitable material such as well-glazed terra-cotta is built into the concrete body of the conduit. In construction, the tubes are secured to the yokes, passing through an opening, as shown; the joints are properly made and concrete filled in around the tube at the same time that it is filled in to form the main conduit. Thus we are able to construct the feed-wire and main conduit all at once. Manholes are placed at suitable intervals on the feed-wire side so as to provide connections with the trolley wire by means of the wire R. Aside from the modified form of the yokes and the angle plates forming the roof of the conduit, the details of construction are the same as in regular cable conduit work.

The single-trolley wire plan with overrunning contact has been selected as being the more simple and less expensive to construct. In such a device we have no contraction and expansion to take care of; the sags in the wire do that automatically. The insulating supports can be placed at a greater distance apart and need not be made so strong as would be required for heavy bars. The overrunnnig contact has the advantage of a direct line of mechanical connection with the car and also an advantage in not requiring wide gaps in the trolley wire at crossings and junctions and in being easily removed from the conduit.

The grooved trolley wheel is rejected, and in place thereof is substituted a cylindrical trolley wheel or roller W, some 4 inches wide at its periphery. By doing away with flanges on the trolley wheel we are also able to do away with deep grooves at frogs and crossings, and thus not only simplify the entire line structure, but get rid of two evils which cause the displacement of the running contact. The trolley roller has ample vertical movement but no lateral movement, it being made wide enough to always be in contact with the trolley wire.

Manholes H with covers M, Fig. 1, are placed at suitable intervals of, say, 20 feet apart in which are fixed the insulated supports for the trolley wire. The insulated support consists of a bar B, sustained by two insulators I I attached to the side of the manhole. One end of the bar B projects into the conduit and supports the trolley wire by means of the usual fixture device.



FIGS. 1 AND 2.—HEWETT'S ELECTRIC RAILWAY CONDUIT TROLLEY SYSTEM.

The trolley wheel or roller W, Fig. 2, is mounted on the end of the lever L, the other end of which is attached to the rectangular carrying frame by means of the fulcrum P and insulated block A. This lever permits the trolley wheel to move freely in a vertical direction so as to conform to the sags in the trolley wire, but does not permit any lateral motion as it is not needed, the roller having sufficient face to always be in contact with trolley wire.

The rectangular carrying frame shown in the longitudinal section, Fig. 2, is composed of two horizontal bars D G joined together by two vertical bars C¹ C², which pass through the slot. The upper bar D is extended the full length of the truck frame and at its ends are fixed two short cross-bars, one of which is shown at E, Fig. 1. The four ends of these short cross-bars rest loosely in four guides attached to the four corners of the truck frame. The guides are shown at F F, Fig. 1, and F² F³, Fig. 2. Two vertical bars C¹ C² are used instead of one, so as to get a more perfect guiding action of the slot independent of the car. The two vertical bars C¹ C² are placed directly under the axles of the wheels so as to have as little lateral variation as possible. The four guides F F F² F³ maintain the trolley frame in a vertical position, but permit it to be guided laterally by the slot and vertical guides c^1 c^2. The whole forms a trolley frame or carrier flexibly connected to the truck frame and guided entirely by the slot. It is easily detachable by withdrawing two pins N N from the guides at either end.

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[1] See The Electrical Engineer, Sept. 21, page 262.

Electrical connection is effected by means of an insulated wire leading from the lever L through protecting tubes Q attached to the inner edges of the vertical bar c^1 thence along the bar D across bar E by wire K^2 K^3 to a spring-snap connection (not shown) on the car floor.

In changing from conduit to overhead wire two pins N N are withdrawn from the guide boxes on the rear end of the truck frame, the spring-snap connection pulled out and the trolley frame blocked fast to the track; then by putting the trolley arm on the overhead wire the car can move on, leaving the trolley frame behind. The frame slips out of the guide boxes and drops down on the slot rails, when it can be switched over to the in-bound track ready to be picked up by the next in-bound car, it being mounted on suitable lifts so as to slide directly into the guide boxes as the car runs over it. The retaining pins can then be replaced, the spring-snap connection restored, and the trolley arm secured, when the car is ready to move forward on the conduit line.

In case of obstruction to traffic the trolley frame can be dropped off, lifted out of the conduit through slot rail gates and transferred to the other track, where it can be picked up by the motor car on the return trip. The trolley device runs in either direction without readjustment and is readily adapted to either a loop terminus or a switch-over terminus.

In case of breaking of the trolley wire, the trolley roller W drops down below the supports B and passes on without injury. Trolley wire repairs are made by splicing in a new section from one manhole to the other. Cylindrical splices are not necessary. A simple plate splice will answer. Where cable gaps are to be crossed, two rollers attached tandem to the same lever will pass with ease and without interruption to the current. With this form of trolley wheel turnouts and crossings are more simple than with the grooved wheel. The grooved frog gives place to a simple plate frog.

The insulators I I are a special form of oil insulator in which oil is fed through the porous part of the insulator and runs off on the inner surface of the cell, thus constantly cleaning and renewing the oil film on the inner surface of the cell. Oil is supplied from a cup formed into the top of the insulator.[1]

In case of inadequate sewerage, and where there is no possible way to prevent the overflow of the conduit, a short section of overhead trolley wire can be erected for use whenever necessary. The trolley wire sections need not greatly exceed the length of the section of conduit subject to the overflow, which in most cases would be short—say one block. The conduit trolley wire should of course be switched out of circuit during such overflow. The same switches can also be arranged to switch the overhead trolley wire into service, the overhead trolley arm being put up while on the overhead trolley section. The conduit trolley runs idle through the water and comes into circuit again when the overhead trolley arm leaves the overhead trolley wire. The overhead trolley wire overlaps the conduit wire so as to leave no break in the motor circuit. The insulated blocks in the conduit trolley can be made of such material as oiled wood or porcelain so as not to absorb moisture while passing through water.

MR. HENRY ALBERT, electrical engineer, has accepted a position as superintendent of the Royal Light, Heat & Power Co. of Front Royal, Va. Mr. Albert has had a large experience, including work in South America.

"ON THE PROSPECT OF STORAGE BATTERIES FOR ELECTRIC TRACTION."

BY

G. Herbert Condict.

IN your issue of Sept. 14, "Gautherot," under the above heading, gives a very clear statement of the present condition of affairs in the storage battery field. The questions asked are of increasing interest to railway men, whose anxiety to obtain economical and unobjectionable power for their street cars is growing day by day. It is most unfortunate that during the last few years so many "new systems" have blossomed out in all the glories of new paint and a most commendable determination "to revolutionize the street railway world," only to be relegated, after a short and not altogether brilliant career, to the realm of the already well-filled past.

The fact that the running of one car "successfully" on a street railway track occasionally, for two or three weeks or months, does *not* demonstrate that a certain "system" is a grand and unqualified success, ought not to require proof at this late day. And yet, less than a month ago, the manager of an electrical company (which, by the way, has been "just about to close large contracts for storage battery car equipments" for some months past) stated that street railways could be operated at a cost nearly sixty per cent. less by his system than by horses, because he had "made most careful and trustworthy estimates, based on figures obtained during the running of a car equipped with this system, on a trial trip around the streets of" a certain city! When the "practical, substantial business men," who are furnishing the hard coin to support the above claim, wake up to the fact that estimates of this character are of about as much value as the paper on which they are written, there will be added to the long list of "fleeced lambs" another contingent. If only the ignorant, and sometimes unprincipled, promoters of such schemes suffered for such failures, very few tears would be shed over the matter, but those who are earnestly and conscientiously striving to solve the problem are so often included in the general condemnation, that it is of great detriment to the whole business.

There are batteries and batteries, many of which have undoubtedly failed to perform what was required of them. There are also other types, by the aid of which the question of storage battery traction will be settled satisfactorily and beyond all doubt. This will be accomplished by the employment either of such durable construction that long life may be guaranteed, or of such simple and cheap construction that renewals may be made at slight cost.

That the complex condition of patent litigation, which has been going on for so long a time, has been one of the worst obstacles in the path of storage battery progress, cannot be doubted. The "ample faith," which "Gautherot" speaks of, is not only dependent on the successful performance of the system, but also on the probability that capitalists will be able to call their own, that on which they have spent money. This part of the question can only be settled by the decisions of the law courts, or by a combination of interests.

Another factor in this slow development is, that generally when real, *serious* operations are to be commenced, a line is selected on which the service is exceptionally severe, owing to difficult grades, poor track equipment, excessively heavy traffic, etc. Undoubtedly the successful system must finally be able to cope with all such difficulties, but it is only reasonable to take hold of the less difficult tasks and then, as experience is gained, grapple with the greater. Because the trolley system grappled with some of the hardest possible conditions in its very infancy, is no reason why the storage battery should be developed along the same lines. In spite of all these obstacles the outlook is good; and so let the "patient public" be patient a little longer—let them take heart and expect soon to see a realization of their fondest hopes.

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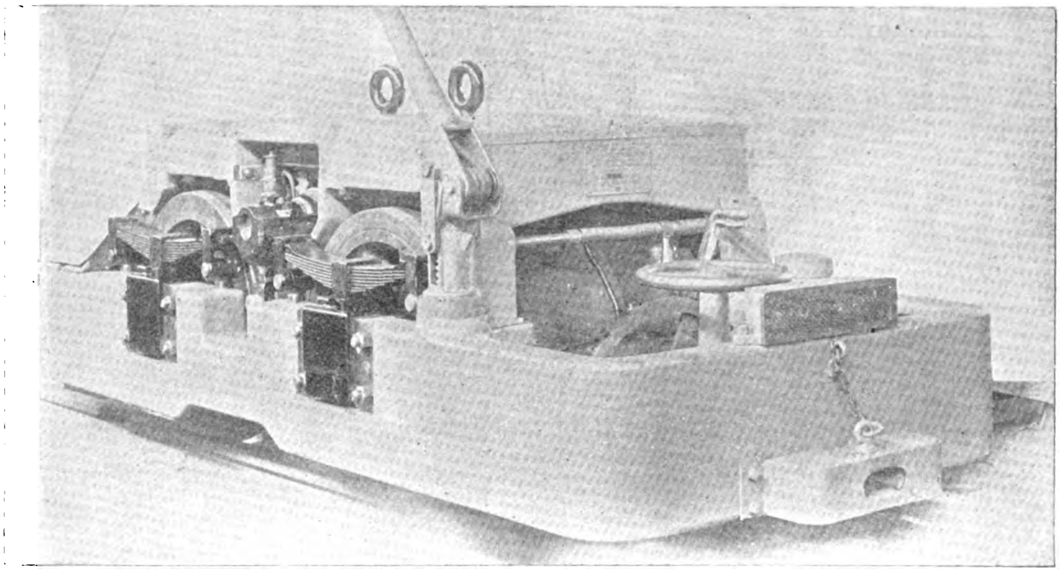
[1] A complete description of this insulator is given in THE ELECTRICAL ENGINEER of March 30 and May 18, 1892.

THE NEW "GENERAL ELECTRIC" MINING LOCOMOTIVE.

We illustrate on this page a new and compact form of electric mining locomotive, introduced by the General Electric Co. It is intended to operate in very low and narrow entries.

The frame consists of a single, heavy, box-shaped casting with recesses in the sides for the axle-boxes. Space is allowed at one end for the operating platform, and at the other end for the rheostat, the motor being placed in the centre. Recesses are also provided in the frame casting for the brake levers and axle gears. The motor is of a type similar to the "W. P." railway motor, and consists essentially of two main castings. The lower casting forms the lower pole-piece, and supports the bearings for the armature shaft, the two intermediate shafts, placed one on each side of the armature, and the field spool. The gears are set in pockets in the frame of the motor, and are completely and tightly covered by the iron castings, thus doing away with the separate gear cases. The top pole piece is part of the upper casting of the motor, and makes a complete cover for it, thoroughly protecting the armature, field spool and other interior parts. The armature itself is of the iron-clad ring type. The two intermediate shafts are placed on each side of the armature, and transmit power directly to both axles. The axle gears are set in fixed bearings supported by the frame of the locomotive, and are fastened to the axle by a flexible coupling of novel design, which allows free movement of the axle in all directions, except a longitudinal one, with reference to the gear and frame. This coupling is built entirely of heavy steel castings, with gun metal linings, so that it will easily withstand the rough wear and tear of mining service.



New "General Electric" Mining Locomotive.

The locomotive is equipped with a new and very simple form of trolley, insulated so that the operator may take hold of it at any part except at the wheel. In case it is necessary to move the trolley wire from one side of the entry to the other, the trolley may be lifted entire from its socket and placed in a corresponding socket on the opposite side of the locomotive.

All connections are automatically made by simply setting the trolley in place. The rheostat used is of the standard railway type provided with a special filling. The brake is a toggle joint made of substantial steel castings. The locomotive is also equipped with headlights and sand boxes. The general dimensions of the 30-6 and 30-10 locomotives as made for a 30-inch gauge are: Draw-bar pull, 3,000 pounds; speed, 6 to 10 miles per hour; length over all,9 feet 6 inches; total height, 36 inches; width over all, 48 inches; wheel base, 40 inches; gauge, 30 inches; diameter of wheels, 28 inches; weight, 15,000 pounds. The same type of machine is made of different capacities, with draw-bar pulls varying from 750 to 4,500 pounds. The locomotive is known as the "G. L. M."

AN ELECTRIC SHUNTING ENGINE.

Messrs. Mather & Platt, of Salford, England, have recently constructed a heavy electric locomotive for use at some large iron works in Sweden. This locomotive is designed to work with an E. M. F. of about 300 volts, and in external appearance is similar to those on the City and South London Railway. The motor is of the double armature type, the motors being connected to the axles through 10 to 1 spur gearing. An overhead wire, 16 feet from the rails, furnishes the current, the collectors consisting of an iron bar at each end of the locomotive, carried on upright pipe pillars.

THE NEFTEL & MARSH CO.

The Neftel & Marsh Co., of 126 Liberty street, New York, has just completed a reconstruction of the electrc line of the Camden Horse Railroad; also the extension of the service to Merchantville. This piece of work was of a difficult and novel nature. The road was previously operated with a two-wire overhead system, and at a potential of 120 volts. The present road is a single-wire 500-volt line, with Westinghouse motors. The change in line work and motors was made without any accident and without stopping the operation of the line; the only time when work was possible without current on the wires was from midnight until 5 a. m. Mr. J. Stanford Brown had immediate charge of this work.

The same company is now installing the electric light plant for the Green Island Electric Light Company, of Green Island, New York, with a capacity of 150 arc and 2,500 incandescent lamps.

DEWEY'S ELECTRIC HEATERS AND RESISTANCES.

ELECTRIC heating is yet in its infancy, but there has been sufficient experience in the use of electricity for heating purposes to demonstrate beyond a doubt, that it is in many respects superior to all other methods of heating. The many great advantages derived by using electric heat, more than make up for the slight extra expense attending its use in places where the cost of current is high. It has been found that the cost for heating electric cars by electricity is even less, in some cases, than heating them with coal stoves, and in other cases the cost was about the same. Allowing that the cost is even somewhat greater, no electric railway company should hesitate to equip its cars with electric heaters when their advantages become fully known. Managers of street railways and others financially interested are always anxious to make passengers as comfortable as possible, and electric heaters, if properly constructed, will go a long way toward making them comfortable, and will increase the patronage of the road.

Stoves in houses are bad enough, but stoves in a car are much worse. They are dirty, disagreeable and unsatisfactory in almost every way. The smoke, gases and ashes are disagreeable and soon make the car dingy and unsightly. The coal stove heats the car more than is necessary in the immediate vicinity of the stove, often scorching and burning the car roof, while the temperature a few feet from the stove is too low. It does not heat the car equally. Electric heaters heat the car equally or uniformly because they are divided and placed in different parts of the car. Electric heaters take up no seat room, being placed under the seats or in the form of a grating upon the floor, while a coal stove occupies the seat room of one passenger. It is not necessary to remove the electric heaters from the car in the summer season as they are light and occupy no valuable space. This allows the car to be warmed on cool days and evenings in the spring and fall. Electric heaters are always ready to start and can be stopped in a moment, after which there is no expense. There are many days in the spring and fall when for several hours in the middle of the day it is too warm and uncomfortable when the stove is heated, but it is kept heated because the evening may be cool. An electric heater may be stopped and started so easily that it is not necessary to run it continually and waste heat. Electric heaters are perfectly safe while coal stoves are dangerous, often causing fires in the barn at night. Properly made, electric heaters are more durable than stoves, for the radiating surface is large and therefore does not have to be heated to a very high temperature which would consume the parts. Coal stoves require expensive fuel while electricity is generated from cheap coal. Electric heaters do not require close attention, thereby allowing conductors to attend to their other duties more closely.

Electric heaters for an ordinary sized car cost no more than a coal stove and take but three amperes of current on a 500 volt circuit. One watt will heat nearly one cubic foot of air space in a car, but will heat between one and one-half and two cubic feet of air space in a house.

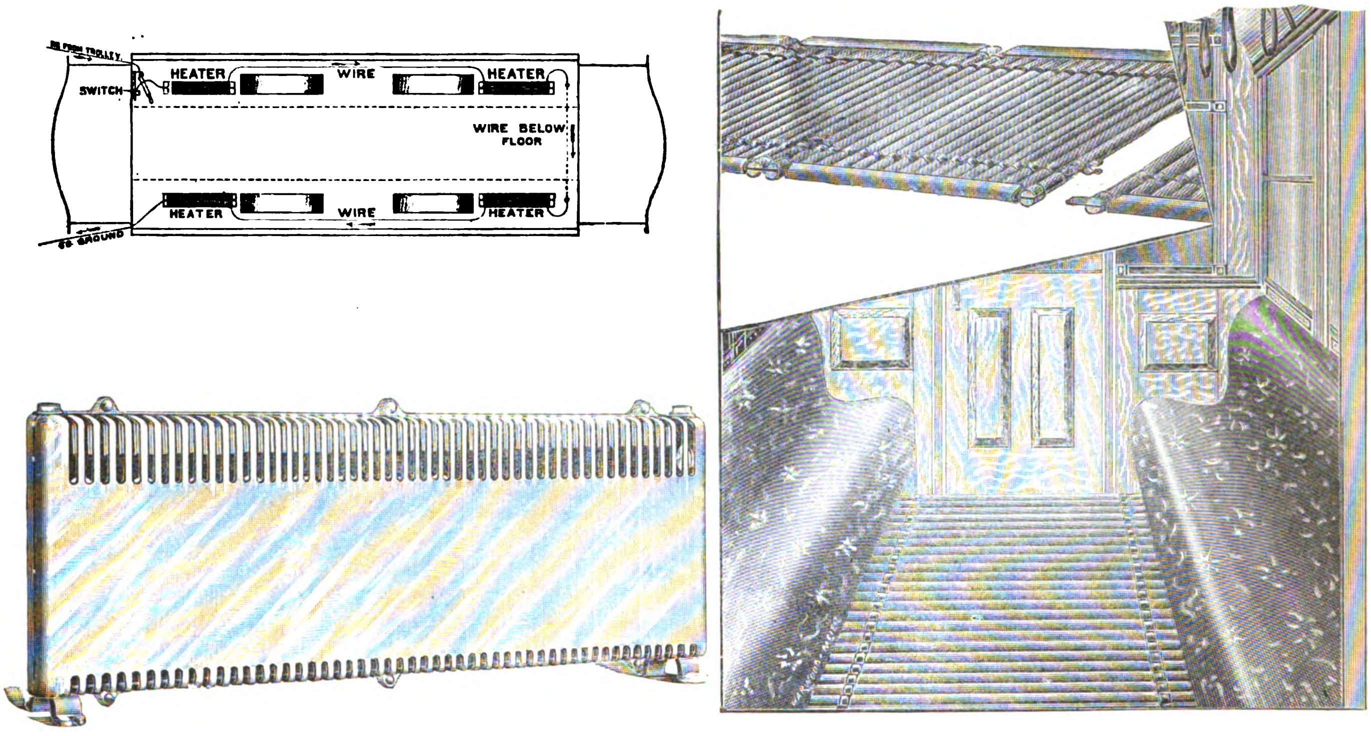
A building cannot be warmed so well and ventilated as thoroughly as by the proper use of electric heat, which is acknowledged by the best authorities to be the most healthful and perfect method. And the apparatus for its generation may be constructed to heat a single room or the largest building with a uniformity that cannot be attained by other methods. If it is not desirable to heat the entire house electrically it is certainly a most convenient way of heating a bath-room or sitting-room in the morning or evening in the spring and fall when the furnace is not running. With heaters for such purposes it would be unnecessary to run the furnace late in the spring or early in the fall and great economy would be derived and much trouble saved.

The electric heater is also better than a stove because it will not produce noxious gases, dirt and dust. The nearer we can get to the conditions of the radiant heat of the sun in warming a room the more healthful the heat will be. This can be best accomplished with electric heating apparatus having a large radiating surface that is not heated to a high temperature.

In the Dewey electric air heater the entire surface of the heating conductor is exposed to the air. It is supported and held firmly by non-combustible or fireproof material, and yet all except a very small per cent. of its surface area is exposed to the air. The case is slotted in the bottom and top, and the heat from the conductor causes the air to circulate rapidly through the case in contact with the heated conductor from which the heat is carried into the room. There is no chance of getting a shock, as all current-carrying parts are shielded and protected. No electric heater can be perfectly economical unless the air can circulate through it in contact with the heated conductor; no stationary solid substance, be it ever so good a conductor of heat, is equal to moving air as a distributor.

The principles just enunciated have been carried out in a variety of forms of Dewey heater, some of which we illustrate below.

Among these Fig. 1 represents one of Dewey's electric car heaters, from four to eight of which are necessary to heat a car, according to the size. The heater case is made of cast iron with a black japan finish. It is 26 inches long, 2 inches wide and less than 11 inches high, and it can be secured firmly to the floor. They weigh about twenty-five pounds each, and occupy but little room under the seats of the car so that they are not in the way. The heaters are generally connected in series on the car as shown in the diagram, Fig. 2. But one switch is in circuit to connect and disconnect the heaters, making their control simple and easy. At one end of the car the heaters may be joined by passing the connection through and beneath the floor as indicated in Fig. 2. Should extremely cold weather appear, one of the heaters may be short circuited if necessary in any suitable manner in order that a greater heat may be generated.



FIGS. 1, 2 AND 3.—THE DEWEY ELECTRIC CAR HEATERS.

Tin or zinc sheets may be secured to the woodwork of the car above and back of the heaters if desired. When the space beneath the seats is paneled in, the panels must be removed to permit the warm air to pass from the heaters into the car. Wire netting may be substituted for the panels if desired.

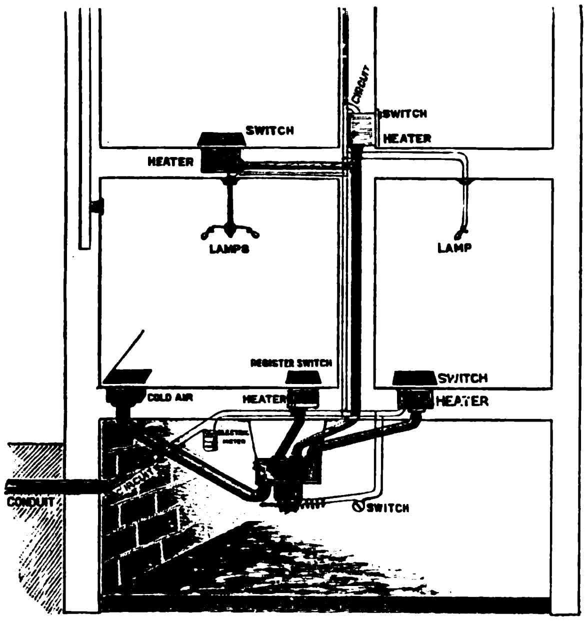


FIG. 5.—DEWEY'S SYSTEM OF ELECTRIC HEATING.

The same style of heaters are made wider than the car heaters for offices and other rooms so that one heater may contain more resistance and generate more heat. The two larger sizes kept in stock are about 7 and 12 inches wide, respectively. These heaters are furnished nickel-plated when so desired.

The Dewey grating or mat heater, shown in Fig. 3, is made in the form of a grating to lie upon the floor or aisle of a car. The grating is made of small gas pipe which encloses the conductor and forms a large radiating surface. The grating is made in sections and is easily removed for cleaning, and replaced. This heater is perfectly safe and durable, forming not only the heater for the car, but also the grating. It is not necessary to heat it above 120° F. at any time to warm the car, so that rubbers or leather will not be injured. It need not cover the entire floor, but only a portion of it, as at the ends of the car, so that it will not interfere with the opening of the trap doors over the motors.

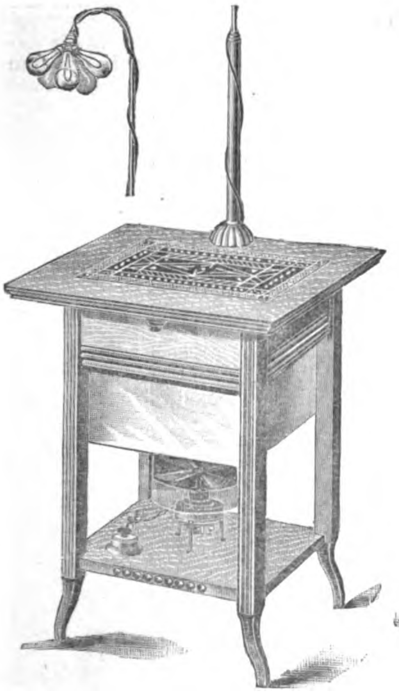


FIG. 4.—STAND AIR HEATER.

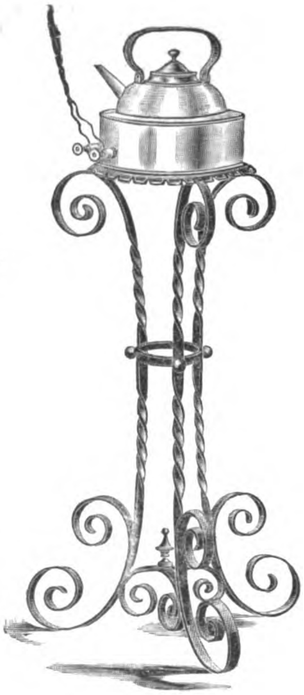


FIG. 6.—5 O'CLOCK TEA.

The Dewey stand air heater, shown in Fig. 4, is made of solid oak, and is highly finished with a beautiful nickel register in the top. The stand is 2 feet 6 inches high and the top is 2 feet square. One of the Dewey hot air heaters of a size sufficient to heat a large sized room, or two smaller ones, is arranged beneath the top in an enclosure of polished copper or nickel. A small fan motor is placed upon the lower shelf of the stand and forces the air of the room rapidly through the heater and register. This is a very rapid and even heater, and is especially adapted for heating a sitting-room or library on cool mornings and evenings in the spring and fall when the furnace is not running, or to supplement the furnace in extreme cold weather. Switches are provided for regulating the heat and the motor, so that they may be operated together, or separately and independently of each other, allowing the circulation of the air in the room in very warm weather when the electric heater is cut out. Several incandescent lamps are supported upon a polished metal fixture on the stand to give light to the room at night. The stand is light and easily moved when upon rollers.

The Dewey air heating system for houses is shown in Fig. 5. In this system the electric heaters are placed beneath registers in the floor or in the side of the room back of the base. Pipes lead from a drum, enclosing a fan operated by an electric motor in the basement or cellar, to the different heaters, so that air may be rapidly forced through them into the rooms, and another pipe is shown leading from a cold air register to the lower side of the drum so that cool air will be drawn from the rooms without taking the extreme cold air from outside. This fan may also be operated without the heaters and the heaters may be connected with the lamp circuit and operated independently of each other.

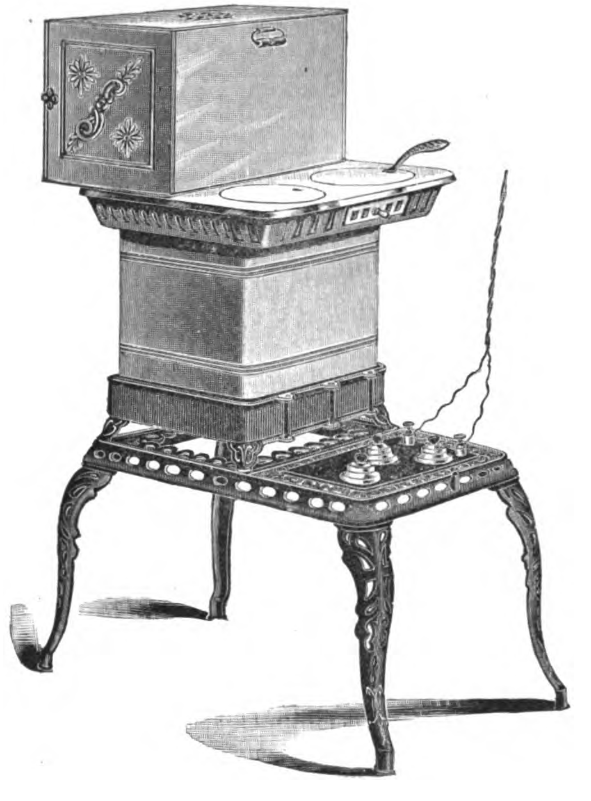


FIG. 7.—DEWEY ELECTRIC COOKING STOVE.

The Dewey kettle heater or "5 o'clock tea," is shown in Fig. 6, The stand is made of wrought iron painted black. The kettle and heater with terminals are of brass; the terminals are insulated from the heater case with porcelain, and asbestos is used to insulate the heating conductor so that there is nothing combustible about it. The heater may be attached by a flexible cord to a lamp socket, and is removable, that is, it may be taken from the stand and placed upon the table. The water will remain at scalding heat two hours after being brought to boiling point, after the current is cut off.

The electric cooking stove, Fig. 7, is three feet high without the oven, and has four griddles and a large double sheet iron oven which can be removed from the stove. It is perfectly safe and is easily controlled. Three different degrees of heat may be obtained by the small switches shown on the base in front. This stove is made for of any voltage.

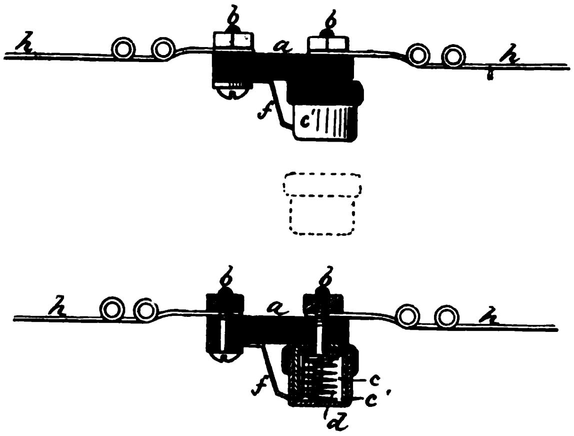
THE DENIO FIRE-ALARM SYSTEM.

BY

Jno. Dennis, Jr.

THE rapid advance in the utilization of electricity in fire service is well illustrated in the new auxiliary fire-alarm system, invented by William L. Denio and installed by the Standard Electric Signal Company, of Rochester, N. Y. In its auxiliary features the Standard Electric Auxiliary System performs functions never before attempted in the fire-alarm system. It is based on the value of quick, "still" alarms, which bring into service the particular fire apparatus which is most convenient to the locality, without alarming the remainder of the fire department unnecessarily.

In case of an alarm of fire, turned in either by manual signal box or a thermostat, the alarm is automatically sent into the fire house or houses on the auxiliary circuit, and the alarm is recorded in the fire department in 15 seconds, and in 22 seconds from the time of pulling the manual signal box or fusing the thermostat, the alarm is returned back to the building gong at the substation. All the auxiliary circuits run into one central station, which consists of a cabinet 2 feet square and 8 inches deep. In case of a service alarm, the number of the substation is recorded on the tape at the central station register, an alarm is given to the central station operator, and automatically sent to the fire house and back to the gong on the building. This alarm at the central station indicates, unerringly, whether the alarm was given by pulling a manual signal, or whether it was given by the fusing of one of the thermostats in the building circuit; thus furnishing an invaluable record for the guidance of fire underwriters.



FIGS. 2 AND 3.—THE DENIO THERMOSTATS.

An additional feature is that, in case of a broken wire in any of the building circuits the number of the box or substation will be recorded at the central station and an alarm given in the central station; thus indicating the location of the break. But no alarm will be given in the fire department; neither will the troublesome single stroke be sent into the fire department. Another valuable feature is the introduction of non-interfering street boxes, in any of the auxiliary circuits, which turn in an alarm to the central station through the same wires upon which the auxiliary substations are situated, and repeat into the fire department through the same central station instruments, as in case of an alarm from an auxiliary box.

The manner in which these various operations are carried out will be readily understood by referring to the accompanying engravings.

The central station consists of a register W, relay 18, sounder *r*, short-circuiting device Y, a return signaling apparatus I and necessary switches and gongs, and a gauge Z, Fig. 1. The substation consists of a signal box F, a building gong P, and wires through the different floors in the building, a manual signal box E and thermostats connected into the wires at desirable points, an automatic switching device, and a switchboard D for cutting out the different floors. The engine house equipment consists of a register and mechanical gong.

Beginning at the battery *h* at the central station, as shown in the diagram, Fig. 1, the circuit extends through wire 1 to binding post 2 to wire 3 and binding post 4 in the switchboard in the building to be protected. It passes around this switchboard and out through the different floors and through the manual boxes and thermostats back to binding post 8 in the switchboard; thence it passes over wire 9, to the base of the subsignal box, thence through the base of the subsignal box to the turning arm 10, to spring 11, to spring 12; thence along wire 13 to the binding post 14 at the building gong; thence taking the street wire 15 it goes into the central office through wire 51, entering the return signaling apparatus I through spring 16 which rests on the circumference of the break wheel *z*; thence through the metallic base of the return signaling apparatus I to wire 17, through wire 17 to the gauge X, and thence through wire 19 to the relay 18, back to the battery *h*; thus completing the normal circuit from the central station to the substation in the building.

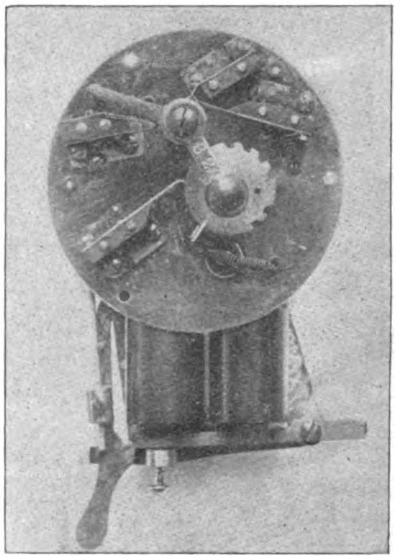


FIG. 6.—SUBSTATION SIGNAL BOX.

There is another battery *i* in the circuit from the central station to the building or substation 1. The course of the current over this circuit is from battery *i* through wire 23 to contact spring 24 in the sounder *r* (this contact spring, with its companion 26, is above and resting upon the armature of the magnets *q*). The current passes from contact spring 24 through the armature 25 (which is a conductor) through contact spring 26, wire 27, to and through magnet 28 (which is in the return signaling apparatus), thence through wire 29, which is the street wire from the central station to the engine house; thence through the gong and register at the engine house and through wire 30 to battery *i*, thus completing the circuit between the central station and the fire department.

Auxiliary to the circuit just described is another circuit extending from the battery *i* through wires 23 and 31 to the metallic spring 32. This is for the purpose of releasing the mechanism of the return signaling apparatus. From spring 32 the circuit extends from wire 31 up a hinged detent 32, along the escapement arm 33, to the base of the return signaling apparatus I; thence

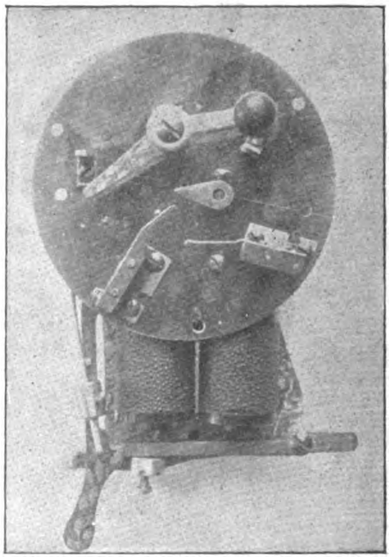


FIG. 4.—SHORT CIRCUITING DEVICE.

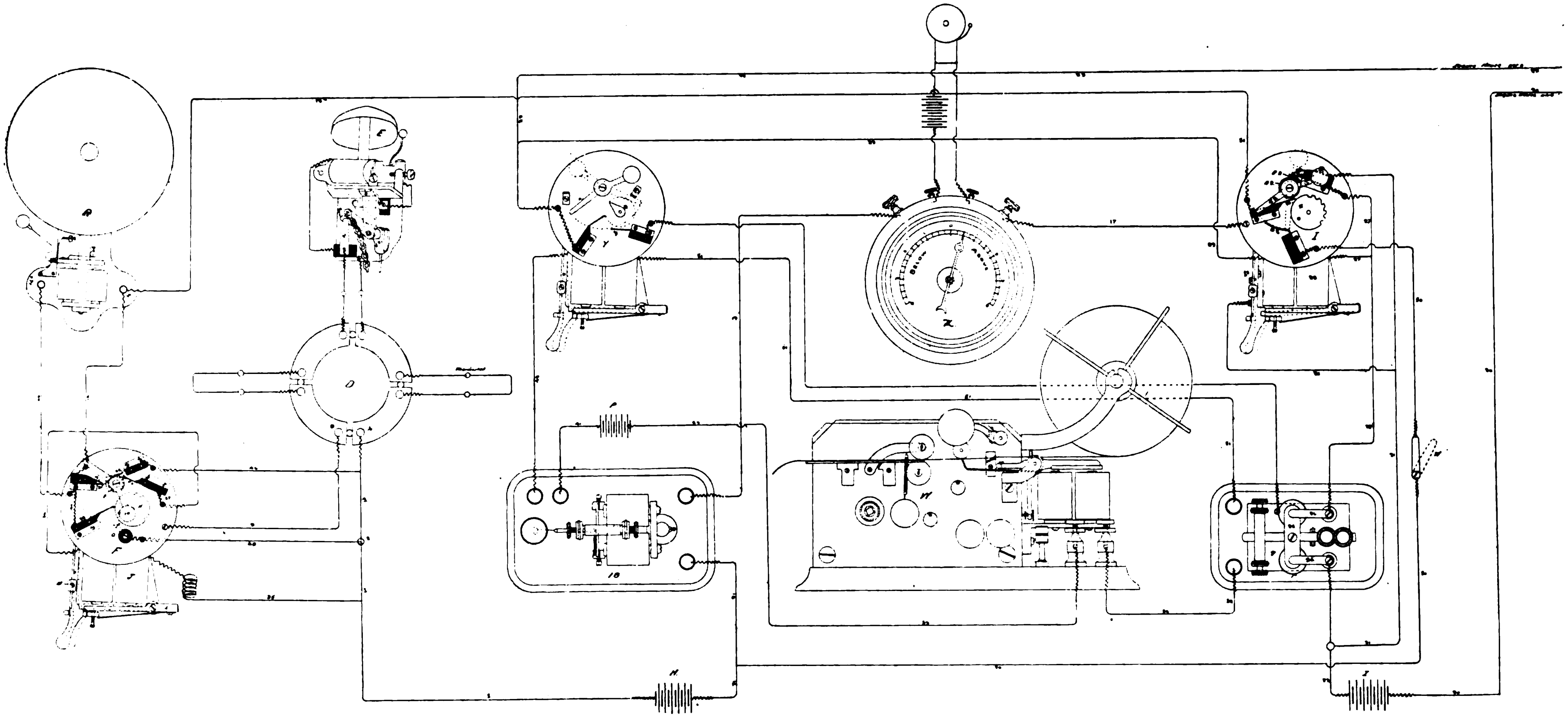


FIG. 1.—THE DENIO FIRE-ALARM SYSTEM.—

DIAGRAM OF CIRCUITS.

through wire 27 through the magnets 28 through wire 29 to the gong at the engine house and thence through wire 30 back to battery *i*.

It will be seen that the object of passing this auxiliary circuit through the return signaling apparatus is two-fold. It enables the alarm sent in from any substation signal box to be turned in to the fire-house, and also, after such alarm has been sent in to the fire-house to send a "return-signal" back to the building at which the substation signal box is located and from which the alarm emanated.

For convenience of reference, a top view has been shown of the relay magnet and sounder while a front view of the other apparatus is given. The wiring, which, for the same reason, is drawn on the face of the diagram, is of course on the back of the central station cabinet, which is only 2 feet square and 6 inches deep. It will be noted that the diagram drawings of the short-circuiting device Y, return signaling apparatus I, substation or manual box and manual signal box, are designed to be exact reproductions of the several pieces of apparatus shown in the engravings, Figs. 4, 5, 6 and 7.

The thermostat which is placed in such places in the building circuit as may be desired, is shown in Figs. 2 and 3. The thermostat, which is simply connected into the building wire, consists of an insulator *a* with two electrodes, *b b*, passing through it, to which the building wires are connected. To one of these electrodes or screws is fixed a metallic thimble, *c*, over which slides a movable thimble *c'* sweated on to the fixed thimble, without the use of acid by solder which fuses at 150 degrees Fahrenheit, or at any higher temperature that may be desired. Between these two thimbles is a coiled spring, which has power sufficient to throw off the outer thimble when the solder is fused in case of fire. A metallic spring *f*, forming a conductor, is attached to the opposite electrode and bears against the outside thimble, thus making the circuit from one end of the main wire to the other through the thermostat. A shoulder, *g*, made of rubber, vulcanized on to the outer thimble, is formed at its top. When the solder is fused and the outer thimble thrown off by means of the coiled spring in the interior, this shoulder strikes the spring *f*, and breaks the circuit at the moment the outer thimble is thrown off. When the outer thimble is off, the metal spring *f* flies back against the surface of the fixed inner thimble, thus re-establishing the circuit. The sliding of the outer thimble off the fixed thimble cleans its surface, so that the contact with the spring *f* with the inner thimble is always certain. It is by thus breaking the circuit that the signaling apparatus in the substation or building box is set in operation, as will be more fully described below.

The manual signal, which is also placed at convenience in the building wires, is provided with two springs 51 and 52 which rest in contact with the connecting bar 53, completing the circuit. n^2 is a snap switch operating the springs 51 and 52 to open the circuit of either. The object of the manual signal is to turn in an alarm by hand by opening and closing the circuit of the building wire in the same manner as by fusing the thermostat. The switch leaves the first spring, opens the circuit and then passes under the next spring and closes it. The magnet will not be charged until break wheel *n* in the substation or building box, in making its second revolution has left spring 45, at which time the short-circuit through wires 46 and 3 is cut out, and the circuit is established through the building again. The manual signal is operated by simply breaking a slender glass tube and drawing down a chain which it encloses.

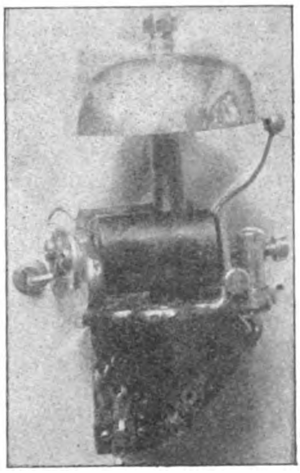


FIG. 7.—MANUAL SIGNAL BOX.

I have now described the normal condition of the system when ready for an alarm of fire. In case of fire, the fusing of the solder in the metal thermostat causes the outer thimble to be thrown off, thus opening and at once closing the circuit in the building. During this instant the circuit, which is then passing along wire 1, seeks a new escape. From binding post 2, instead of passing through the wires in the building, which are momentarily cut off, the current passes along wire 85, which forms a shunt, to and through a resistance coil in the substation box, and thence through the magnets J in the substation box, energizing them; thence it passes along wire 36 to spring 37 and thence to the swinging tongue 10, which is then in contact with spring 37, to spring 11 and thence by normal contact to spring 12 on to wire 13 to binding post 14. thence along the auxiliary wire 15 to wire 51, and thence through the central station apparatus, as before described, back to main battery *h*.

It will be noted, however, that the action of energizing the magnets in the substation box has released the signal machinery, and it has begun to operate During the brief interval while the circuit is broken by fusing the thermostat, or by operating the manual signal, the circuit through the building is cut out; but it is established again as soon as the new contact is made in either case, as described.

But the circuit does not pass through the service wires of the building again until the metal swinging arm 10 in the substation box after leaving spring 37 makes contact with spring 45 which forms a short circuit from spring 45 through wires 46 and 3 to binding post 2, thence through wire 1 to battery *h*; from battery *h* to wire 21 to relay 18 at the central station, wire 19 to gauge, wire 17, through the return signaling apparatus I through its break-wheel *z*, out through spring 16 which rests on the surface of break-wheel *z*; through wire 51 to auxiliary street wire 15, to the binding-post 14 at the building gong, through wire 13, springs 11 and 12, wire 40 to spring 38, to the brake-wheel *n*, to base of the substation, to the swinging arm 10, to spring 45, thus completing the circuit again. It is by this means that the circuit is maintained between the battery and the central station when the service wires in the building are cut out by the action of the thermostat or manual signal

During the instant that the current is broken in the building wires the charging of the subsignal's magnets draws up armature *l*. This armature holds normally an escapement *m*, which is thus released, and the substation mechanism begins to operate. The movement resembles in some minor respects an ordinary district movement. The contact spring 38 rests on the break-wheel *n*, which is notched for its particular number. On the shaft of this break-wheel is a metal tongue, 10. The entire substation apparatus is driven by a single time movement. When the movement of the break-wheel begins, this tongue shifts from the contact with spring 37 to contact with spring 45. The current is thus changed and now passes from the binding post 2, through wires 3 and 46, the spring 45, the metal base of the apparatus to the break-wheel. Thence it passes through the spring which rests on its notched rim through wire 40 into spring 11, and by contact into spring 12, and thence on the main line through wire 13 and the binding post 14 at the building gong. As the break-wheel continues to revolve, the spring, resting on its rim, engages with the notches which indicate the number of the substation. The result is that as the spring engages these notches the circuit is alternately opened and closed.

It will be seen by a glance at the diagram that this alternate breaking and making of the circuit will alternately demagnetize and magnetize the relay magnets 18 at the central station, and operate on the gauge with its connected gong and alarm bell in the central station cabinet, the relay 18 and gauge being in the main circuit. The demagnetizing of relay magnet 18 closes an independent local circuit in the central station.

This local circuit may be thus described: From battery *p*, through wire 41, to relay 18, wire 42 to magnets in the short-circuiting device, thence through wire 51 to sounder *r*, wire 52 to register and from register through wire 53 back to battery *p*. Opening and closing the local circuit has two effects. First it energizes the magnet *s* and releases the driving mechanism of the central office register and second, it alternately magnetizes and demagnetizes the magnet *q*. The office of the last-named magnet is to operate the sounder. At the same time it releases mechanism of the circuit closing device, which operates in unison with the mechanism of the substation box. This short-circuiting device is in the engine house circuit, and is provided with an arm *x* which revolves with the mechanism. As soon as the first number of the substation has been recorded on the tape on the central station register, arm *x* in the short-circuiting device comes in contact with contact point *y*. This contact momentarily makes a new circuit through the engine house gong, and momentarily short-circuits the magnet *j* in the return signaling apparatus allowing that apparatus to move during the second revolution of the break-wheel at the substation. The instant the arm *x* leaves contact point *y* the orginal circuit to the engine house through magnet 28 is restored, and the shunt circuit broken.

The return signaling apparatus, which is for the purpose of turning the alarm into the fire department and also for the purpose of afterwards repeating the alarm on the vibrating bell at the building or substation, has not yet been fully described. It consists of break-wheel *z*, similar to the break-wheel in the substation box, except that it is notched indifferently to cause an intermittent alarm on the building gong at the substation. Against the rim of the break-wheel rests a spring 16. There is a closing circuit insulated wheel, a^2, which revolves coincidentally with the break-wheel *z*, having on its side a lug b^2. The object of the lug, as will appear below, is simply to bring springs 46 and 47 in contact. There is a metal tongue c^2 attached to the shaft of the circuit closing wheel which revolves with it, and whose office it is in its revolution to strike an insulated spring d^2 and close a circuit.

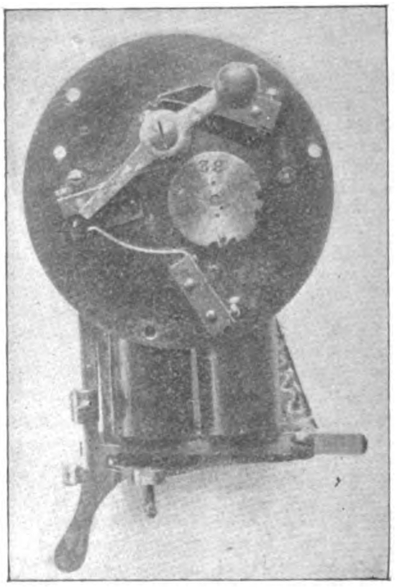


FIG. 5.—RETURN SIGNALING APPARATUS.

The signal is not repeated into the fire department during the first revolution of the break-wheel in the substation box, although during that first revolution, it is registered on the tape at the central station. During the second revolution of the break-wheel the operation is identically the same as during the first, excepting that the substation box has, by means of the return signaling apparatus, been placed in circuit with the fire department, into which it repeats its signal during the second revolution of the substation break-wheel. This is done by opening and closing the circuit at springs 24 and 26 (in the central station sounder), by the movement of the armature 25 up and down. The circuit to the fire department is then made from battery *i* through wire 23, spring 26, wire 27, magnets 28, wire 29 to engine house and wire 30 back to battery *i*.

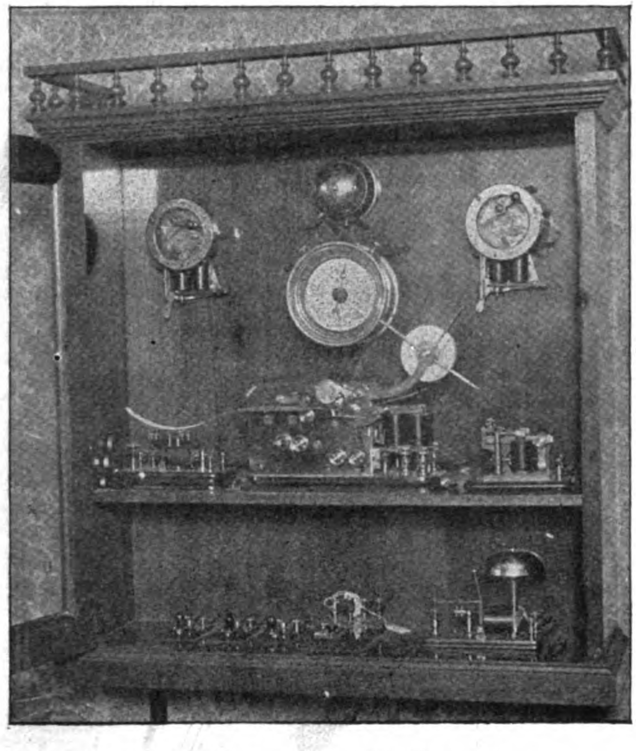


Fig. 8.—Central Station Apparatus.

While this action is taking place the break-wheel *z* and the circuit closing wheel in the return signaling apparatus are both revolving. Now, when the break-wheel *n* in the substation box has completed its second round, it comes to a stop, and its swinging tongue 10 strikes the contact spring *o* which is connected by wire 48. A new circuit is thus made through wire 48, spring *o*, swinging tongue 10 (which is in contact with the spring *o* at the time) and into spring 11 by the lug f^2 on the swinging tongue striking spring 11, breaking the circuit between springs 11 and 12; thence through wire 49, through the building gong, through the main line back to battery *h*. This short-circuits the service wires in the building. While this has been going on the circuit closing wheel a^2, in the return signaling apparatus, has turned sufficiently to bring lug b^2 in contact with spring 47, thus forcing spring 47 in contact with spring 46, and closing an additional shunt circuit from battery *i* through wires 27 and 31. This merely closes an additional circuit from battery *i*, the object of which is to prevent any alarm whatever being given in the fire house, unless it emanates from the break-wheel *n* in the substation box.

Now, the further revolution of the wheel a^2 in the return signaling apparatus, brings c^2 in connection with the insulated spring d^2. This makes a new circuit in which the current passes from battery *h*, through wire 21 and wire 50 to spring d^2 through the arm of c^2, (then in contact with d^2), through the shaft of wheel a^2, the base I, the break-wheel *z*, spring 16, wire 51 to wire 15, where it connects with the main circuit. This takes out the resistance of relay magnets 18 and gauge magnet. While the tongue c^2 is in contact with spring d^2, and the relay magnet 18 and gauge magnets are out of circuit, the break wheel *z* has come into position so that the notches in its rim act upon the spring 16 to alternately open and close the circuit and this sounds the vibrating gong P at the building or substation. The break-wheel *z* continues to revolve until the tongue strikes a stop on the break wheel when the movement stops, the tongue c^2 still remaining in contact with the spring d^2 and preserving the current. Under these conditions gong P will continue to ring until a switch, W, is opened to break the current. By this arrangement it is impossible to get a signal into the fire department except in case of fire, and when the signal is so given it is sure of being repeated to the building by sounding an alarm on gong P, showing that the fire department has been notified.

We will now illustrate the action of the apparatus in case of a broken wire instead of fire at the substation. In case the wire is broken at the substation, the current is permanently cut off from the building and not re-established, as in the case of the thermostat. The action is the same during the first round of the break-wheel *n*, as in the case of fire. The revolution of the break-wheel *n* operates the sounder *r* and registers the number at the central station, but during the second round of the break-wheel *n* a change takes place.

In case of fire the current through the service wires in the building is only momentarily cut off by the action of the thermostat and then re-established; but in case of a broken wire it is permanently cut off, and not re-established. During the first revolution of break-wheel *n* the swinging tongue 10 remains in contact with the curved spring 45, and maintains the circuit; but during the second revolution of the break-wheel the tongue 10 leaves the spring 45, and the whole current of the main line is cut off, until the tongue 10 strikes the contact spring *o*, when it is re-established. Consequently magnets 18 are demagnetized, the local battery *p* is closed, the magnet *q* is energized, the armature of the sounder *r* is drawn down permanently and does not vibrate, as in case of fire, and a vibrating alarm is given at the central station and the number recorded. The action of drawing down the armature 25 separates it from the contact springs 24 and 26. In such case the shunt current through the return signaling apparatus is not broken; consequently the current through the fire department is not interrupted and no alarm will be sounded at that point.

The apparatus is manufactured by the Standard Electric Signal Company, Nos. 31 and 32 Smith's Arcade, Rochester, N. Y. The officers of the company are: C. H. Blakeslee, president; George A. Benton, vice-president, and C. C. Hicks, secretary and treasurer.

THE KINSMAN RAILWAY BLOCK SYSTEM.

Year after year improvements have been made in the construction, equipment and management of railroads. In every department wonderful advances have been made. The link and pin have given way to the automatic coupler, which, with its strong platform and the vestibuling arrangements, have made telescoping almost an impossibility; the strap rail and the light iron tee rail have been superseded by heavy steel rails laid upon roadways which are marvels of engineering skill in alignment, grades and construction; the wonderful air-brake has superseded the weak and inefficient hand-brake; the movement of trains is regulated by telegraph from central dispatching offices, where formerly trains ran on chance; and on the best roads expensive and ingenious signaling systems have been put in use.

But, notwithstanding all these improvements, our railroads are still liable to dreadful accidents due to the fact that the trainmen are dependent upon their eyesight alone to determine when the conditions are favorable for the safe conduct of the trains committed to their care.

In order to render the safety of passengers independent of the vigilance of the engineer, the Kinsman Block System Company, of 143 Liberty street, New York, have introduced an apparatus, details of which are shown in the accompanying illustrations, devised with a view to stopping a train at any determined point without the intervention of the engineer, and 26 miles of railway near Chicago is now being equipped with the apparatus. The system is entirely automatic. When the visual signal is set at "danger" a current is thrown into a rail placed upon the sleepers opposite the signal post, and resembling an ordinary guard rail. When a train passes over this rail, electrical connection is established between it and an electromagnet in the cab of the locomotive which immediately closes the throttle and applies the air brakes upon the entire train. The apparatus for accomplishing

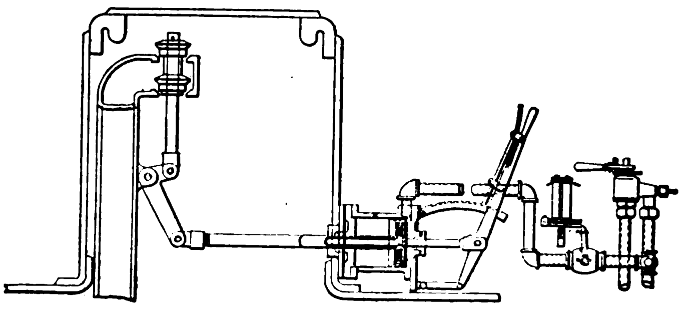
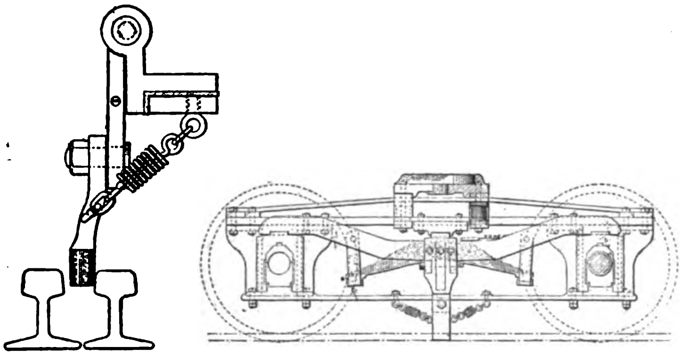


Fig. 1—The Kinsman Railway Block System.

this is fixed between the throttle lever gland and the boiler head. The operation is shown in Fig. 1. When the air valve is opened by means of the trip actuated by the armature of the magnet, air is admitted to the cylinder surrounding the throttle lever spindle, its pressure forcing the piston to the left and closing the valve. The inner spindle, however, remains stationary, the outer portion of the sleeve being forced to slide upon the inner, while the air pressure overcomes the power of the springs that hold the piston against the inner spindle. The springs, four in number, are sufficiently strong to hold the two spindles together during all ordinary movements of the throttle by hand, and the throttle can, therefore, be kept locked at all times.



Figs. 2 and 3.—The Kinsman Railway Block System.

After the piston has been pushed beyond the port opening to the atmosphere in the upper side of the cylinder, the air escapes and applies the brakes, in the same manner as would the opening of the train pipe at any other place. This port is made of a size suitable to produce an ordinary application of the brakes. To provide for making a sudden stop, the size of this port is made adjustable so that it can at any time be instantly enlarged by the engineer, a light lever for this purpose being fixed where he can conveniently press it with his foot.

The electric rail is placed 1⅞ inch from the track rail, and the contact arm, shown in Figs. 2 and 3, is attached to the locomotive truck. This arm runs in the flangeway, and is therefore as free from danger of obstruction as the wheel itself.

The Kinsman block system can be used in connection with any kind of signals, and is capable of various modifications. The visual signal can also be dispensed with if desired. Tests extending over a period of nearly three years on the Peterboro and Shirley division of the Hoosac Tunnel route near Ayer Junction, Mass., show that the details of the apparatus have been carefully perfected.

THE SUCCESS ARC LAMP.

Of all the devices for utilizing the electric current the arc lamp in appearance was the crudest and clumsiest in design. Both consumers and manufacturers have begun to recognize this fact, and are demanding a lamp of graceful, compact design and handsome finish.

Especially is this true where the arc lamp is brought into close proximity and comparison with the artistic and beautiful fixtures used in incandescent lighting. What is wanted, evidently, is a lamp whose standard design is artistic and graceful and which shall cost no more than the present clumsy affair. With the object of fulfilling these conditions, Mr. S. L. Phillips, of No. 120 Liberty street, this city, has brought out the "Success" arc lamp, which has been designed specially to operate on incandescent circuits.

The lamp is illustrated in the accompanying engravings, Fig. 1 showing the type employed for inside lighting, which is ordinarily 36 inches long, but can, if required, be shortened to 22 inches. The lamp intended for outdoor use is shown in Fig. 2, being 32 inches long.

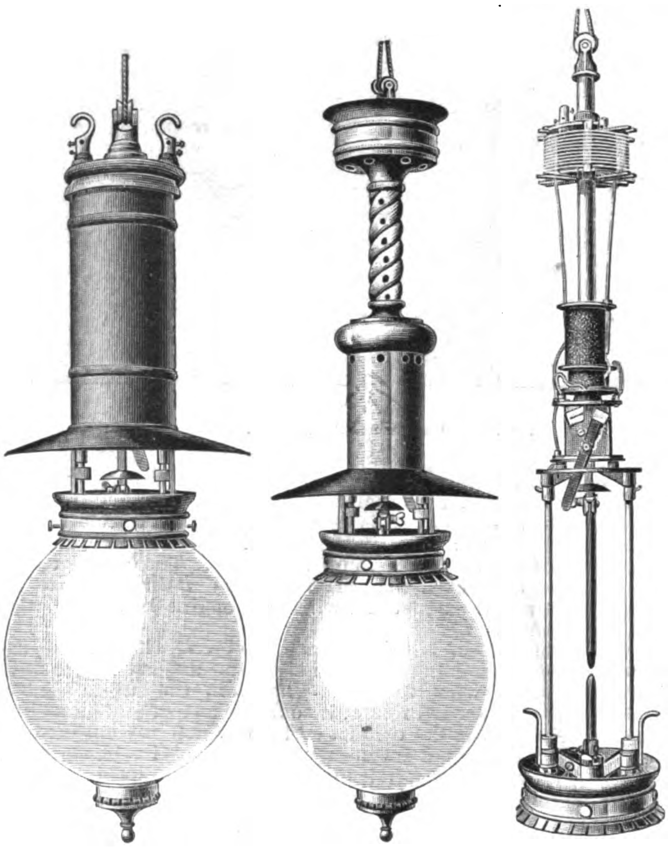
The mechanism of the lamp is clearly shown in Fig. 3. By a very ingenious device, the single 8-hour lamp is converted into a double or 14-hour lamp. This result is obtained by introducing a hollow lower carbon holder with a bayonet tripod cap. From this tube the lower carbon is fed upward, as the carbon burns away, by a spiral spring coiled beneath it.

The characteristic feature of the lamp is its simple mechanism, and the fact that no compensating springs, weights or dash pots are used. The carbon rack is fed by a simple clock train, and is raised or lowered by the difference in pull of the main and shunt coils. The carbons are normally separated and maintained so by the weight of the solenoid core, which has a pawl upon its lower end that plays into the teeth of the pinion and lifts the rack. When the current is turned on, the shunt coil lifts this core, releases the pinion, and the carbons come together; the main coil then immediately separates them and strikes the arc. The main and shunt coils are placed one above the other and the carbon rack passes through the centre of both of them, and through the core just described.

The lamp is wound with its proper resistance, and for isolated plants or electric railway circuits, where the potential is likely to vary, an extra resistance equal to the resistance of the arc is provided, which is automatically cut in, in case the lamp goes out, thus saving the shunt coil from burning out.

The lamp being wound for the voltage it is intended to be used on, and being a purely differential lamp, cannot get out of adjustment, and hence requires no regulating; and no means for regulating are provided, thus doing away with the possibility of derangement at the hands of trimmers and inexperienced men in the station. The insulation of the lamp is very complete, so that exposed parts can be readily handled, and the lamp itself is completely protected from grounds. The resistances are wound entirely upon fireproof material, and ventilated so that overheating cannot occur. Each lamp is provided with a specially designed and patented snap switch.

These lamps can be run singly, two in series, ten in series, or five in series from the outside wires of an Edison 3-wire circuit, and can be wound for any amperage, however low. They are nominally wound for 7 to 8 amperes and 45 volts.



Figs. 1, 2 and 3.—The "Success" Arc Lamp for Incandescent Circuits.

FRED. H. WHIPPLE AGAIN.

Some of our readers will remember the word of warning against the peculiar financial methods of Fred. H. Whipple printed in The Electrical Engineer of September 30, 1891. The following paragraph from the *Pittsfield Evening Journal* of September 26 is not without interest in that connection:

> Fred. H. Whipple was arraigned in the district court this morning for inducing Clarence G. Tompkins of this city to sign a $100 draft on false pretenses. On August 2, Whipple represented that he was authorized to draw on the funds of the Fred. H. Whipple Company at New York, and Mr. Tompkins signed the draft as an indorser and was just that amount out. A warrant for Whipple's arrest was recently sworn out, and Chief Nicholson hied him to Ohio after securing the necessary requisition papers. He returned this morning with Whipple in his custody. In court the case was postponed until Friday. Whipple was placed under $1,000 bail but didn't secure it. Congressman Crosby and Lawyer Wilcox will defend him. It is said that he secured money in a similar manner from two other Pittsfield people. The defendant engaged three lawyers and made a desperate attempt to defeat Chief Nicholson's effort to bring him to this city. His counsel offered to pay all expenses and all the money obtained if the case could be dropped. The court there sustained in every particular the view taken by Chief Nicholson.

Whipple's capture was effected in Cleveland.

G. A. R. ELECTRIC ILLUMINATIONS AT WASHINGTON.

THAT public fêtes and celebrations without electricity to enhance their splendor and give to them the necessary eclat, are becoming rare, has been very adequately proved during the recent gathering of the Veterans of the Grand Army at Washington. The celebration was to be so grand in the daylight, that for it to have failed in the evening, when, parades over, the visitors were free to promenade Washington's magnificent thoroughfares would have cast a serious reflection on the committee in charge. It was felt that electricity only would satisfactorily answer the purpose, and therefore it was adopted as the sole means by which a thoroughly brilliant illumination could be obtained.

To the Decorative Lamp Department of the General Electric Company, which distinguished itself at the Actors' Fund Fair last May, was confided the arduous task. The results elicited admiration and approval from every one, either visitor or resident.

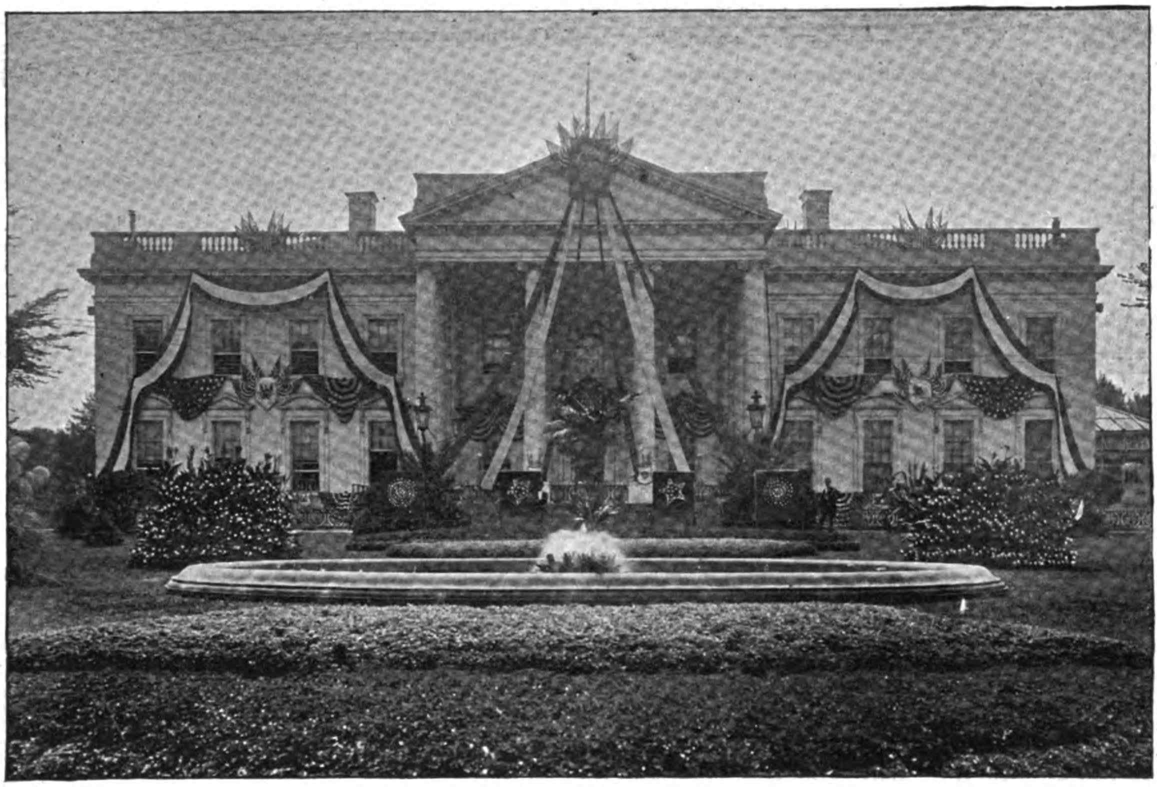
The interest in the reunion centered itself about Pennsylvania avenue, stretching from the White Capitol to the Treasury and the Executive Mansion, and it was determined that the electrical display should also be centered there. Running from near the Pennsylvania Railroad Depot to the Treasury, pole lines were erected on both sides of the avenue. At short intervals along these two lines different corps badges were designed in small but intensely brilliant incandescent lamps, each corps badge being repeated three times at various points on the avenue in the national colors of red, white and blue. Above each corps badge, the name of some notable fight in which the corps took conspicuous part, or well-remembered sojourning place during the war, was written in electric lamps. At rarer intervals the portraits in oil of the leading war generals were suspended, each surrounded by a double border, the inner one of very small lamps, the outer of lamps of a larger size and higher candle power.

At the corner of Tenth street, in front of the *Washington Post*, was erected a splendid anchor, about 20 feet high. When lighted it blazed so brilliantly as to make it the most attractive set piece on the avenue. In front of the *Washington Star*, twin stars of red and blue were placed, and a patriotic device gleamed from within the office windows.

At the head of the avenue at the entrance to the White Lot was erected the most conspicuous design of the occasion. It was a monster fac-simile of the G. A. R. badge, 18 feet high entirely made up of incandescent lamps. The eagle was outlined in white lamps, the cannon in blue, the stars and stripes in the regulation colors, and the pendant star in amber lamps. This piece was duplicated at the corner of Seventeenth street below the White House. From the Children's Stand, at the head of the avenue, the name of Lincoln, in white lights, evoked pathetic reminiscences from the veterans.

The illumination of the Treasury Building presented considerable difficulty. This was overcome by arranging along the cornice at the top of the fluted columns, a line of colored arc lamps, which stretched from the entrance to the White Lot almost entirely around the building. The red, white and blue globes of the lamps lent themselves admirably to the colors of the flags with which the building was hung. Colored arc lights were also used to illuminate the camp on the White Lot.

On the White House lawn, in front of the Mansion, a most fairylike effect was produced. Every bush, tree, fern and flower bed glistened with the light of innumerable miniature lamps, so suspended as to conceal all the mere practical details of installation. No less than 10 revolving stars, each of different design, were also set up here, constantly changing in design and color, reappearing and disappearing. Over each entrance to the Mansion was set a star of deep blue lamps. A marvelous effect, and one never yet essayed to add to the brilliancy of an illumination, was obtained by the introduction of the search light. On the roof of the Washington Loan and Trust Company's Building were set four 24-inch General Electric Company's projectors built at Middletown, three facing the Capitol and one facing the Monument. During the evening the brilliant rays of light from these projectors shot the national colors on the clouds, or illuminated the surroundings of the city. The most marvelous effects were obtained, however, when the whole four were brought to bear on the Capitol or on the Monument.



ELECTRICAL ILLUMINATION OF THE WHITE HOUSE, WASHINGTON, D. C.

All this remarkable display was not obtained without great effort. Less than 30 days elapsed between the commencement of the work and the illumination. Poles had to be erected, and a whole 3-wire system installed, drawing current from every available dynamo, public or private, in the city. In fact, not enough current could be procured.

Two G. A. R. badges, 68 corps badges, the same number of mottos and names, special devices such as the Anchor and Stars, had to be designed and executed. The streets had to be skilfully wired and socketed, the revolving wheels to be designed and constructed. Projectors had to be brought from the factory and erected. It was a great undertaking brought to a satisfactory termination. Some idea of the work can be gained from the fact that over 25,000 incandescent lamps were used in the illumination, as well as over 100 arc lamps.

Credit for the success of the illumination is to be rendered to Mr. A. D. Page, to whom *carte blanche* had been given, and to Mr. F. H. Clarke, the Washington representative, who were materially assisted by Mr. Fanshawe and Mr. McAllister, both skilful designers and versed in lamp requirements. The search lights were in charge of Mr. Gragg.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED SEPT. 20, 1892.

Accumulators :—

Storage Battery, E. R. Knowles, Brooklyn, N. Y., 482,979. Filed Oct. 15, 1891.

Employs a support plate for the absorptive material consisting of a central part provided with a connecting lug and downwardly turned flanges, and two outside parts; the flanges holding the three parts together.

Alarms and Signals :—

Electric Signaling Device for Firemen, G. L. Barnard, 482,778. Filed July 24, 1891.

A telegraphic signal between the pipeman at the nozzle of the hose and the engine tender.

Signal Telegraph, C. V. Boughton, Buffalo, N. Y., 482,780. Filed July 22, 1891.

A method of transmitting messages by sight by means of lamps whose relative positions and combinations indicate the different figures, letters or characters.

Dial Transmitter, F. Pearce, New York, N. Y., 482,877. Filed May 3, 1892.

A central station instrument for fire-alarm telegraphs giving facility to the operator for repeating the signal to a large number of circuits with comparatively small battery power and repeating the signals automatically.

Conductors, Conduits and Insulators :—

Composition Coating for Paper Tubes, S. Bergmann, New York, N. Y., 482,718. Filed March 4, 1891.

Claim: A coating for a tube or conduit consisting of a mixture of plumbago and plaster of paris.

Insulated Electric Wire, T. L. Reed, Providence, R. I., 482,753. Filed May 31, 1890.

Employs a textile wrapping filled with a composition of bitumen, wax and oxide or oxidizable oil.

Insulator, C. T. Lee, Boston, Mass., 482,872. Filed Nov. 14, 1891.

Employs an insulating block composed of sheets of mica pressed together, the block having a parallel sided seat and an outer shell partially enclosing it.

Insulator, H. H. Brooks, Cambridge, Mass., 482,913. Filed Oct. 26, 1891.

A tree insulator consisting of a cylinder of insulating material placed loosely in a holder having projections which partially enclose it and keep it in place.

Joint for Electric Conductors, J. W. Marsh, Pittsburgh, Pa., 483,074. Filed Dec. 21, 1891.

Employs a recessed supporting block of insulating material holding the adjacent ends of the corresponding conductors of the cable.

Dynamos and Motors :—

Armature Winding for Dynamo-Electric Machines, R. Eickemeyer, Yonkers, N. Y., 482,825. Filed Sept. 3, 1890.

A winding composed of strands of wire bent into various forms and constituting separate series, the strands of each set having a form peculiar to themselves and all secured in place by pins in holes in the ends of the armature cores.

Electric Locomotive, C. M. Conradson, Madison, Wis., 482,863. Filed Dec. 2, 1891.

Has for its object to combine the advantages of geared and gearless motors, and is so arranged that gears may be made use of where necessary, and their use discontinued where unnecessary, at will.

Alternating Current Motor, O. T. Bláthy, Buda-Pesth, Austria-Hungary, 482,974. Filed Dec. 7, 1891.

Employs two sets of field-magnet coils supplied from a source of simple alternating current and self-induction coils and condensers connected with the field magnet circuits by means of which the currents are displaced in phase.

Lamps and Appurtenances :

Suspension Bracket for Electric Lamps, T. Dillon, Indianapolis, Ind., 482,727. Filed July 9, 1892.

Carbon Holder, E. P. Warner, Chicago, Ill., 482,820. Filed Apr. 21, 1892.

A carbon holder having three points of contact for the carbon and a recess above the points whereby a swinging motion of the carbon in any direction is permitted.

Frame for Electric Arc Lamps, W. E. Bossert, Utica, and J. H. Findlay, Ogdensburg, N. Y., 482,940. Filed Oct. 24, 1891.

Electric Arc Lamp, J. A. Stuart, Philadelphia, Pa., 482,986. Filed July 20, 1891.

Has for its object to provide means for entirely relieving the regulating mechanism from the weight of the upper carbon holder of the first set of carbons in a duplex lamp when the second set is brought into use.

Attachment for Electric Lamps, J. Clift, Dorking, Eng., 483,044. Filed Mar. 2, 1892.

A reflector and holder for electric lamps.

Miscellaneous :—

Electrolytic Apparatus, T. Craney, Bay City, Mich., 482,724. Filed Jan. 2, 1892.

Employs an anode consisting of a body of carbon arranged to expose a number of separate horizontal surfaces, and a cell of non-conducting material enclosing the anode and having openings leading to the surfaces.

Means for Reducing Friction, G. M. Guerrant, New York, N. Y., 482,902. Filed Oct. 7, 1891.

Employs permanent magnets exerting attractive force upon a rotating shaft in a direction opposite to that of the weight-reducing friction upon the bearings.

Branding Stamp, J. S. Fitzmaurice, Sydney, New South Wales, 483,050. Filed Aug. 17, 1891.

An electric branding iron.

Electrical Stop-Valve, A. Franke, Berlin, Germany, 483,108. Filed May 6, 1892.

Game Apparatus, S. H. Johnson, Chicago, Ill., 483,115. Filed Oct. 5, 1891.

An electrical dice thrower.

Railways and Appliances :—

Conduit for Electric Railways, F. O. Blackwell, Boston, Mass., 482,719. Filed Dec. 4, 1890.

Claim 3 follows: In an electric railway conduit the combination of transverse yokes and an inverted channel-slot iron forming a shield over the supply conductor with an upright slot rail forming the other edge of the slot.

Electric Railway Conduit, R. M. Hunter, Philadelphia, Pa., 482,964. Filed Sept. 23, 1886.

A slotted conduit having an upper longitudinal compartment and a lower drainage compartment opening into one another, and a conductor carried on insulated supports in the upper compartment.

Closed Conduit for Electric Railways, L. P. Bunce, Minneapolis, Minn., 482,998. Filed Sept. 10, 1891.

Employs a supplemental conduit within the main conduit provided with a series of hinged plates closing the opening in the supplementary conduit when the trolley is not actually passing a given point.

Trolley Stand for Electric Railways, J. C. Hough, Pittsburgh, Pa., 483,061. Filed Dec. 21, 1891.

Employs a disc having helical springs upon its opposite sides in combination with a trolley pole socket forked to pass astride the disc and springs to engage alternately free of the springs.

Switches and Cut-Outs :—

Electric Switch and Case, A. Wright, Providence, R. I., 482,936. Filed May 31, 1892.

Consists of a shaft carrying contact blocks, an arm pivoted by links to guide blocks which are drawn together by springs forcing the contact block to the farthest point of rotation.

Circuit Switch, G. W. Russell, Jr. and D. B. Minor, Denver, Col., 483,123. Filed June 1, 1892.

Employs two solenoids placed end to end and connected by a brass tube in which is located a movable soft iron bar adapted to reciprocate as the current is passed through the helices, for the purpose of controlling any desired number of incandescent lamps from a distance.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the meeting of the council of the Institute, on Sept. 27th, the following 16 gentlemen were elected to associate membership:

Albright, H. Fleetwood, electrical engineer, Western Electric Co., 227 South Clinton street, Chicago, Ill.
Armstrong, Chas. G., electrical expert and electrical architect, 1301 Auditorium Tower, Chicago, Ill.
Callender, Romaine, electrician, Brantford Electrical Laboratory, Brantford, Canada.
Crandall, Chester D., assistant treasurer, Western Electric Co., 227 South Clinton street, Chicago, Ill.
Fisher, George E., general manager, Commercial Electric Co., 55–57 Gratiot avenue, Detroit, Mich.
Flesch, Charles, electrical engineer, Melbourne, Australia.
Jackson, J. P., assistant professor of electrical engineering, Penn. State College, State College, Pa.
Kinsman, Frank E., electrical engineer, Plainfield, N. J.
Magenis, James P., editor the *Adams Freeman*, Adams, Mass.
MacFadden, Carl K., chief electric light inspector, Chicago and Northwestern Railway Co., 22 Fifth avenue, Chicago, Ill.
McBride, James, superintendent, New York and Boston Dye Wood Co., 146 Kent street, Brooklyn, N. Y.,
Noll, Augustus, New York Electric Equipment Co., Duane street, New York City.
Ray, William D., electrician of local line of Northern Pacific R. R. Co., at Chicago, 308 Home avenue, Oak Park, Ill.
Rodgers, Howard S., electrical engineer, Thomson-Houston Electric Co., 624 Western avenue, Lynn, Mass.
Ross, Robert A., engineer in charge of engineering department Edison General Electric Co., Peterborough, Ont.
Smith, Frank Stuart, superintendent of carbon department Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa.

At the evening session, a paper of the utmost interest and value was read by Mr. Chas. P. Steinmetz, on The Law of Hysteresis.

During the evening session the subjoined report of the committee on method of electing officers of the Institute was unanimously adopted, and became part of the constitution:

During the first week in February of each year the secretary shall mail to each full and associate member of the Institute a list of members; a list of the offices to be filled at the ensuing annual election in May, giving the names of the incumbents, and a copy of this rule, with the request that nominations, propositions and suggestions as to desirable candidates be made promptly and prior to March 1.

The secretary shall submit all answers to the Council, who during the month of March shall prepare a complete ticket to be headed "Council Nominees," containing the names of members whom they deem best suited, all circumstances considered, for the offices falling vacant. This ticket shall be printed on the same sheet with a "General Proposal List" containing the names of all eligible members proposed, with a memorandum stating the reason of ineligibility of all other names proposed, and with a statement that the nominations by the Council are in nowise governing, but are intended only to assist members in making a choice. The voting shall be restricted to the names on this sheet. This sheet, together with an envelope, on which shall be printed the address of the secretary, and the words "Voting Envelope—Enclosing a Ballot Only," shall, not later than the 15th of April, be mailed by the secretary to every member in good standing.

Each member may cast three votes for vice-presidents and he may cast all three votes for one candidate or two for one and one for a second, or one for each of three. Each member may cast four votes for managers, which he may in like manner divide between from one to four candidates. This division shall be specified by the appropriate numeral marked opposite the desired name.

All names voted for shall be written, printed or otherwise marked on a single ticket or ballot, which shall be enclosed in a sealed, unmarked and unidentified envelope of any suitable size, to be in its turn enclosed in the voting envelope received from the secretary. On this outer envelope the member shall add his signature, and the postage stamp.

At the annual meeting, these outer "Voting Envelopes" shall be opened in the meeting room by two tellers, then and there appointed by the presiding officer. After all the inner envelopes shall have been thoroughly commingled, they shall be opened and the votes shall be counted by the tellers, who shall report the results in writing. The eligible persons receiving the greatest number of votes for the respective offices shall be declared duly elected. The tellers shall reject all names that do not appear on the "Council Nominee" list or the "General Proposal" list, and they shall also reject that part of a ballot which shall name for any office or offices more candidates than there are vacancies.

This method of election shall apply to the offices of president, vice-president, treasurer and manager. No unsalaried officer except the president and treasurer shall be eligible to immediate re-election to the same office (as provided in Rule IV). The secretary and any other salaried officer shall be chosen each year from among the members of the Institute by the Council. The secretary shall be a member of Council, but shall have no vote in its proceedings.

CLEVELAND MEETING OF THE AMERICAN STREET RAILWAY ASSOCIATION.

SECRETARY W. J. RICHARDSON has issued his final circular letter with reference to the annual meeting which is to be held at Cleveland, Ohio, on October 19, 20 and 21, at Association Hall. The hotel headquarters will be the Hollenden. Railway fare at the special rate of a fare and a third for the round trip will be obtainable in the usual way.

The programme of the meeting will run as follows: *Reports of Special Committees.*—Special committees will report on the following subjects: "A Model Electric Street Railway Roadbed, and Underground Wiring;" "A Perfect Overhead Electric Construction;" "Economy of Machine Shops for Electric Street Railways;" "Power House Engines;" "Relative Cost of Operation of Horse, Cable and Electric Roads," and "Standards for Electric Street Railways." Notice has been received by the secretary that special papers will be read under the following titles: "Experiments on the Expansion of Continuous Rails," and "Is a Standard Rail Head Possible?" Upon the request of the executive committee, Mr. D. F. Longstreet has consented to prepare, and will read, a paper narrating the events which led up to the formation of the American Street Railway Association.

The local committee has secured ample accommodations for all who desire to exhibit their manufactures. Mr. H. J. Davies, secretary of the Brooklyn Street Railroad Company, of Cleveland, has special charge of this department.

The Cleveland Street Railway Companies, supplemented by the Short Electric Railway Company, propose to entertain all who attend the meeting, in a way to be remembered. The annual banquet will take place on the evening of Thursday, October 22.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

An advertisement benefits by the company it keeps.

MR. C. D. SHAIN TO REPRESENT SIEMENS & HALSKE IN THE EAST.

AS we go to press the intelligence reaches us that Mr. Chas. D. Shain, of 136 Liberty street, has been appointed to represent the Siemens & Halske Electric Co. of America, having charge of the Eastern agency. Owing to this important arrangement Mr. Shain will have charge of their business in the New England and Middle States, Virginia and West Virginia. Our columns, this week, illustrate some of the apparatus of the company, which has as high a reputation in Europe as Mr. Shain enjoys in this country. This business combination is a strikingly strong one.

W. R. BRIXEY AND KERITE.

THE following important notice has just been issued to the electrical trade, regarding the old and well-known "Kerite" insulated wires and cables, whose headquarters are at 203 Broadway, New York:

> Having succeeded to the celebrated Day's "Kerite" insulated wire and cable business, I beg to state that after a close and personal study, both as superintendent and general mannger for 14 years in the manufacture of the same, I am prepared to supply wires, cables and tapes of the highest standard.
>
> My personal experience in each part of this business enables me to meet the wants of customers in every detail, and I bespeak a continuance of favors so generously accorded in the past.
>
> Yours very truly,
> W. R. BRIXEY.

A host of friends will extend their good wishes to Mr. Brixey on this continuation of the business with which he has so long been prominently connected, and of which he now remains in sole control.

E. W. BLISS & CO., LIMITED.

THE above concern, of 17 Adams street, Brooklyn, N. Y., have been steadily adding a Western trade to their large Eastern business, and now have opened a store at 14 North Canal street, Chicago, where they will carry a representative line of presses, drop hammers and sheet-metal machinery. The store is situated at the centre of the machinery district of Chicago. Mr. C. W. Ellsworth, until recently superintendent of the Chicago Stamping Co., will be in charge, and will be ready to attend to orders for anything that pertains to punching, shearing, drawing, stamping, perforating, forging and embossing by means of machinery.

THE FORD-WASHBURN STORELECTRO COMPANY.

A VERY interesting pamphlet on their storage battery has been issued by the above company, of Cleveland, Ohio, where they have made some really remarkable demonstrations in street railway and other work. One novel feature of the cell is that it has a porous cup to hold the active material, as the result of which it will stand the severest short-circuits. The pamphlet says:

> Not only will the Ford-Washburn battery stand repeated discharges, in this way, on dead short-circuit, without injury, but it will remain in first-class condition for an indefinite period of time, when unused, on an open circuit. The company has had a fully equipped car running in Cleveland, Ohio, and the batteries have been frequently tested for the heaviest possible sudden discharge. In November, 1891, some 60 of the cells were taken out of the car and examined. They were found to be in good condition. The battery was then about half discharged. In May, 1892, they were examined again and found still in splendid condition. The other half was used experimentally in the same month of May, on incandescent lamps, and showed absolutely no falling off from disuse. This is only what might be expected. The heavy discharge cannot "buckle the plates" because there are none to buckle. All the expansion and contraction of the active material is taken up by the corrugated lead well in the cell, and there are no lozenges or plaques of active material to become loosened or dislodged, either when the cell is in use or when it is supposed to be standing in idle safety.

In addition to references to the many articles on the battery that have appeared in the technical journals, the pamphlet includes a number of testimonials from leading citizens of Cleveland and experts who have witnessed and tested the performance of the Ford-Washburn car.

J. JONES & SON.

A REPORT has been in circulation that this well-known firm are about to close up their business at 39 Vesey street. We are informed by them that this is erroneous. Contrary to such a step, have added to their business quarters by acquiring the controlling interest in a large and well-equipped machine shop at 60–62 Murray street, known as the J. M. Lambert Manufacturing Co., where their manufacturing will be carried on in the future.

The removal of this part of their business has left on their hands a well-fitted machine shop at 39 Vesey street for sale, which has no doubt given rise to the above report.

Not only are they able to offer better facilities by this move, to their customers in the manufacturing line, but they have more room and time to enlarge their supply and construction department at their old quarters, a part of their business which they are vigorously and successfully pushing.

THE UNITED STATES GOVERNMENT APPROVES THE RIES SOCKET.

THE subjoined is an interesting extract from the report of a test made at Mare Island Navy Yard, California, by Lieut. C. F. Pond, U. S. N., to the Naval Observatory, Washington, D. C.

> "Upon using the electric lights at the Transit Pier, one for illuminating the field of the transit, and one for reading the level and finding circle, as mentioned in the report of last year, it was found desirable to have lights which might upon occasion be reduced in intensity. To accomplish this end, two Ries regulating sockets were procured which perfectly fulfilled the purpose for which they were intended, allowing seven (7) distinct or different degrees of brightness, from simply a dim glow to the full power of the lamp. In fact, when fully turned on, the Ries regulating socket gives an intensity of about two (2) more candle power than is given by the ordinary socket. Two lamps with spiral filaments were procured, the filament of this lamp is short and well removed from the socket, thus giving off less heat, and the light is nearly all concentrated in the spiral, which gives a better illumination of the field, with a lesser intensity in the light, thus fulfilling all the requirements sought.
>
> It was suggested by the Ries Electric Specialty Co., of Baltimore, from whom the sockets were procured, that it might be advisable to separate the socket from the lamp, but as the socket generates no perceptible heat in itself. that was found unnecessary.
>
> The Ries regulating sockets are a very valuable adjunct in the use of electric lights in astronomical or other instrumental work. As now fitted, the electric lights at the Transit Pier are a very great convenience, a saving of time and trouble, not to mention the gain in neatness by doing away with the old oil lamps."
>
> Respectfully,
> LIEUT. CHAS. F. POND,
> Lieut. U. S. N.

F. P. LITTLE & CO.

THE above progressive firm of electrical engineers of Buffalo, N. Y., report that in addition to their other large contracts now on hand, they have just closed two more, of an important character; one with the Buffalo Furnace Co. for 31 arcs and 250 incandescents, and one for equipping the fine residence of Mr. G. V. Foreman on Delaware avenue, Buffalo, for a complete outfit of bells, speaking tubes and incandescent electric light wiring. The two contracts aggregate about $7,000.

METALLIC VACUUM PUMP LITIGATION.

THE BEACON VACUUM PUMP AND ELECTRICAL CO. have instituted proceedings for infringement of their patents on metallic vacuum pumps, against Berrenberg Bros. of Boston.

NEW ENGLAND NOTES.

The Westinghouse Electric and Manufacturing Company, through their Boston office, have recently made the following sales of railway apparatus: New Haven and West Haven Street Railway Company, New Haven, Conn., ten car equipments, each car having one 20 h. p. single-reduction motor; Norwich Street Railway Company, Norwich, Conn., three car equipments, consisting of two single reduction 20 h. p. motors for each car; Amesbury and Haverhill Street Railway Company, Amesbury, Mass., two car equipments of two 20 h. p. motors to each car; Worcester Consolidated Street Railway Company, Worcester, Mass., an addition to their Westinghouse system of two car equipments of 20 h. p. motors to each car; Hartford and Wethersfield Street Railway Company, Hartford, Conn , one 250 kilowatt generator, and two car equipments of two 30 h. p. motors to each car; Holyoke Street Railway Company, Holyoke, Mass., one car equipment consisting of two 20 h. p. motors.

Swan & Lane, of Boston, who commenced business about six months ago as general electrical engineers and contractors, have received lately a number of good contracts for wiring. Their most recent contract is one for a 300-light plant for the Mount Battie Woolen Mills, Camden, Me., where they will, in addition to the wiring, supply all the material, including a Jenney dynamo, for which they are New England agents. Mr. F. A. Swan has recently returned from Augusta, Me., where he has been personally superintending the wiring of the new opera house in that city, the finest theatre in the State of Maine. Five hundred lamps will be used, and Mr. Swan himself arranged the switchboard and dimmers for stage effects.

The Sawtell Company, of Boston, have opened offices at 243 Franklin street, for the sale of incandescent lamps of all voltages and candle power, and capped for all standard sockets. They are also equipped for the renewal of burned-out incandescent lamps, being the New England agents for the Davis Electrical Works, of Springfield Mass,, who have equipped a factory for this purpose. Burned-out lamps will be received and new filaments put in, and the renewed lamp returned, the Sawtell Company agreeing to do this at a considerably lower cost than the price of a new lamp. Mr. A. H. Sawtell is general manager of the company and will be glad to furnish all information.

The Young Men's Christian Association, of Boston, through their indefatigable secretary, Mr. James L. Gordon, are calling attention to their evening classes in electricity and other sciences. The class in electricity was opened for the first time last fall, and so great has been the success in this department that they are going to make this winter's class even more attractive.

The Berlin Iron Bridge Co., of East Berlin, Conn., are building a new machine shop for the Mather Electric Co., at South Manchester, Conn. The building will be 52 feet wide by 150 feet long, the central portion being 35 feet in width and controlled by a 15-ton traveling crane. The design is a combination of iron and wood, all the heavier parts of the building being of iron.

The Sawyer-Man Electric Co. have sold through their Boston office alone for the month of September over 25,000 lamps—probably the largest month's business they ever did in this territory.

CANADIAN NOTES.

Montreal Electric Railway.—The new management of the Montreal Street Railway Company, since August 1st, when work was begun, have been energetically pushing work on the introduction of the trolley system, and successfully inaugurated electric traction on September 21st, by the opening of a belt line of four miles of single track, extending from the centre of the city to the exhibition grounds. In addition, one of the old lines, that on St. Catherine street, consisting of four miles of double track, was equipped and in operation some ten days later. For present use the company has twenty motor cars of American manufacture and fifteen of Canadian make, besides which, for the complete equipment of all the lines, 100 cars have been ordered from the United States and a like quantity in Canada. These cars are to be equipped with two single-reduction motors of 25 h. p. each, of Royal Electric, Westinghouse, and Edison Companies' manufacture. The greater portion of these motors will be furnished by the Royal Electric Company, whose motors have given excellent results. No power house is to be built for the present, power being furnished in the meantime from the lighting stations of the Royal Electric Company.

The Central Electric Light Co., of Montreal, Limited, will apply for incorporation, with a capital of $500,000. The object of this company, of which Mr. Louis Perrault is chairman of the provisional directors, is to meet the increasing demand for electricity for light, heat and power. Its intention is to acquire the plant and business of the Perrault Electric Light and Power Co., and to equip, for the present, a station in a central locality of sufficient capacity to supply some 500 arc and 3,000 incandescent lights, besides electric power to the extent of 500 h. p. The company will tender for the lighting of the city of Montreal, the present contract for which expires next year, and, if successful, will largely increase the capacity of its station.

Mr. W. J. Morrison, who has so long represented the Fort Wayne Co. in Canada, has now removed from Toronto to Syracuse, where he will continue to look after and develop the large business that he has now built up in New York State, in the same apparatus.

NEW YORK NOTES.

W. S. Chesley & Co. owing to increased business, find it necessary to enlarge their quarters, and are now fitting up a new machine shop 50 x 75 at 24 Morris street, Jersey City, near Cortlandt Street Ferry, and will have facilities for repairing all kinds of electric light and power apparatus. It is the practice of this company to buy apparatus, outright or, if preferred, to receive it on consignment, repair it if necessary and sell it on commission at the owner's price. They also solicit the manufacture of electric appliances and specialities. They still retain their agency for the Easton Electric Company, of Brooklyn, who manufacture arc dynamos with automatic regulator, slow-speed incandescent dynamos and motors ; and they desire to employ salesmen.

The Union Railroad Company has put in operation a number of its trolley cars, of the Thomson-Houston make, within New York City limits, very successfully. The plant is equipped with four Thomson-Houston generators run by four Cooper-Corliss engines of 350 h. p. each and the station has room for 5,000 h. p. capacity of engine and dynamos. The station is situated on the Bronx River.

WESTERN NOTES.

The Central Electric Company are preparing an exhibition at their warerooms of Interior conduit and supplies, erecting a house complete, showing the method of wiring and the connections by junction boxes, etc. The exhibition will be interesting and practical.

D. A. Andrews, Jr., of Pettingell-Andrews Co., the prominent electrical supply dealers of Boston, Mass., was in Chicago recently, and a caller at the Western office of The Electrical Engineer.

Tracy H. Clark and Chas. S. Marshall of the firm of Clark & Marshall, No. 413 The Rookery, Chicago, have gone to St. Louis, Mo., on a business trip to show their many fine specialties.

Mr. Dwight B. Dean, of the McGuire Manufacturing Co., has just returned from a trip to the coast. He reports business as excellent.

SOUTHERN NOTES.

Mr. W. S. Atchison, the special agent at Atlanta, Ga., for the Short Electric Railway Co., has recently closed a contract for the first electric road to be operated in South Carolina, that of the Columbia Electric Street Railway Light & Power Co., Columbia, S. C. The electric equipment will consist of sixteen 20 h. p. single-reduction motors, and two 133 h. p. multipolar generators, with five miles of line construction, all of the Short system. Water power will be used, furnished by Victor turbines.

Mr. William Oswald, general manager of the Southern Electrical Manufacturing & Supply Company, Limited, of New Orleans, La. has closed contract with the Camperdown Central Refinery, of Baldwin, La., for 220 incandescent lights, with engine. His company have just completed the central station plant for 1,600 incandescent lights at Algiers, La. The station is equipped with four Edison dynamos and two New York Safety engines, and is one of the finest plants in the South.

PHILADELPHIA NOTES.

Merchant & Co. have stopped entirely the importation of their three grades of "guaranteed roofing plates," and are now manufacturing the plates at their works, 2025 Washington avenue, Philadelphia. Cards of admission, not transferable, can be obtained to these works upon request. The concern state that they are securing much better results from the domestic manufacture than they ever obtained with the imported.

The Partrick & Carter Co. are meeting with remarkable success with their new automatic set-back annunciator, the cost of which is a very little over that of their regular style annunciator.

Messrs. W. H. Weston & Co. are running night and day filling orders for switches and switchboards. They are just completing a large switchboard for F. P. Little & Co., of Buffalo.

THE INTERIOR CONDUIT SYSTEM IN SAN FRANCISCO.

The Edison General Electric Company, of San Francisco, has just completed in the new Mills Building, of that city, one of the most complete conduit systems installed in this country.

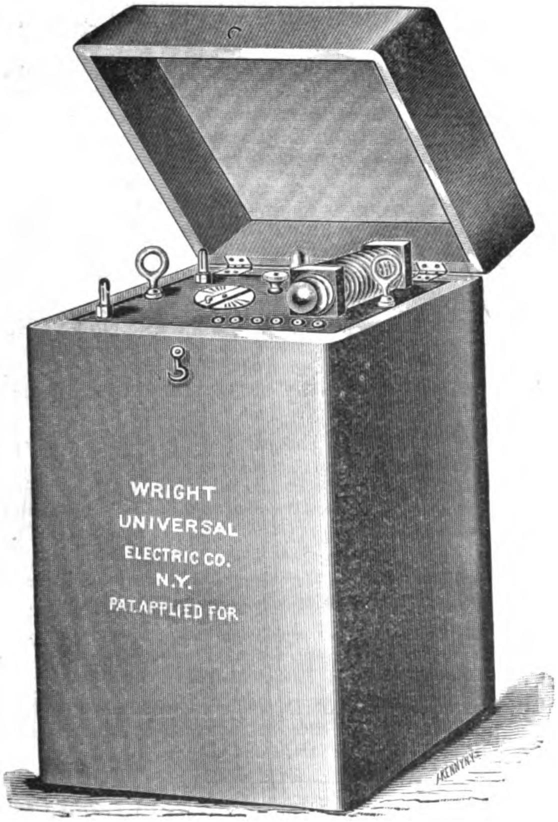
The Mills Building, situated on the corner of Montgomery and Bush streets, is thoroughly fireproof, and is constructed of yellow brick; it has ten stories in the main building, with an addition on the roof. The method of conduiting this building has, perhaps, been different from methods heretofore employed.

The architects, Messrs. Burnham & Root, of Chicago, bore in mind that a conduit system was to be employed and made provisions for the reception of the same as they would for gas or water systems. The system employed is practically as follows: The main feeders all rise in a pipe shaft, each floor being fed by a separate feeder, there being in all some 24 tubes, including motor circuits. The hall mains are all fed from a cut-out box located in a toilet closet by the shaft. These mains are run around the corridor on either side, and are conveniently located behind an oak cornice, which corresponds with the general finish of the building. Cut-outs are intersected in these mains, one in front of each office or room, and are concealed behind a door in the cornice. From this cut-out the office circuit is fed. The branch circuits are one-half inch conduit coupled and telescoped within a three-quarter inch tube, and are run above the tiling of the office they feed. Each office circuit is controlled by a switch conveniently located in the oak finish by the door. The hall circuits are also fed from the corridors, and are upon a separate system. They are also double tubes and are protected from acids and alkalies which might percolate through the cement upon which the marble flooring is laid by having the ashes and earth used for deadening removed from around the tube which is then raised by small pieces of tubing laid crosswise beneath it so as to leave a space entirely around the conduit. This is then filled in with plaster of paris, which forms a cheap and ample protection.

The conduit employed is that of the Interior Conduit and Insulation Company, of New York. The system was installed under the supervision of a representative of that company, Mr. Paul Oscanyan, who has spent five months on the work in San Francisco.

THE WRIGHT COMBINATION PRIMARY BATTERY.

This battery shown in the accompanying illustration consists of a three-compartment glass jar, and is a single-fluid battery with no odor, no creeping of salts and is hermetically sealed. The little outfit is most compact and complete, in a handsome polished oak case, and has a weight of only five pounds. It has an E. M. F. of six volts giving from six to ten amperes. The raising of a little nickel-plated knob puts the battery in action, and upon simply pushing a button, the contact is broken, and the elements are removed from the solution. A coil is placed on the top of the cell and inside the cover, (as usual). On this cover is a small switch with contact steps so arranged as to give galvanic, faradic or cautery currents as desired, as well as a suitable current for lighting the miniature lamps now so commonly used by physicians and dentists. This battery is placed on the market by the Wright Universal Electric Co. The battery is charged with a solution of their "electric sand" and pure water, no acid, whatever, being used. The cost of this charge is claimed to not exceed two cents.

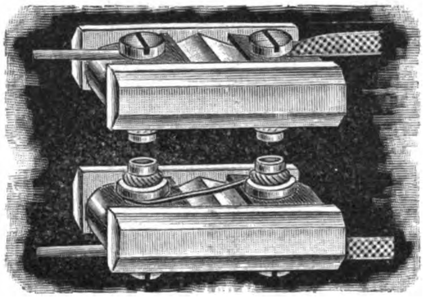


Wright Combination Primary Battery.

This battery and a number of other interesting novelties, among which is an ingenious electric headlight for bicyclists, will be exhibited at the American Institute Fair, which opens on the 10th of October.

NEW "LIGHTNING BUG" FIXTURE CUT-OUT.

The accompanying illustrations show a new fixture cut-out, the invention of Mr. Duane N. Gleason, of the E. P. Gleason Manufacturing Company, who are making and introducing it. This fitting is called the "lightning bug" cut-out to distinguish it from the several other fixture cut-outs made by the same firm.



Figs. 1 and 2.—"Lightning Bug" Fixture Cut-Out.

The "lightning bug" possesses some unique features; for instance, the leading in and out wires are secured under the flat screw heads, as shown in Fig. 1. These screws are inserted into and pass through brass strips on each end of the cut-out; the strips, being bent into U shape, the screw enters it near each edge and serves to keep the brass in position on the porcelain block.

On the reverse side of the cut-out, Fig. 2, will be seen the fuse wire, secured by washer and nut to each of the terminals of the leading in and out wires, the fuse wire being inserted independently and without disturbing either of the main wires. This feature is very important, as many know who have tried to fuse an old style cut-out in which the fuse and main wires are loosened when one of the terminal screws is slackened up. In the "lightning bug," the main wires need never be disturbed at their terminals for fusing after once being put in position.

The "lightning bug" is making many friends, and the Gleason Company are daily receiving orders from those who have seen a sample.

THE SCHUCKERT ELECTRIC PROJECTORS.

The display in connection with the Columbus Celebration to be held in Chicago on Oct. 11, 12 and 13 will include the operation of two parabolic search lights made by Schuckert & Co., of Nuremberg, Germany. These search lights will have an illuminating and penetrating power claimed to exceed any projectors ever employed in this country, being of the same type as the Schuckert search lights now in use in nearly all the navies and armies of the great European powers. Messrs. Schuckert & Co. have appointed Mr. Fred. W. Tischendörfer their representative at the World's Columbian Exposition.

THE GENETT AIR BRAKE FOR ELECTRIC CARS.

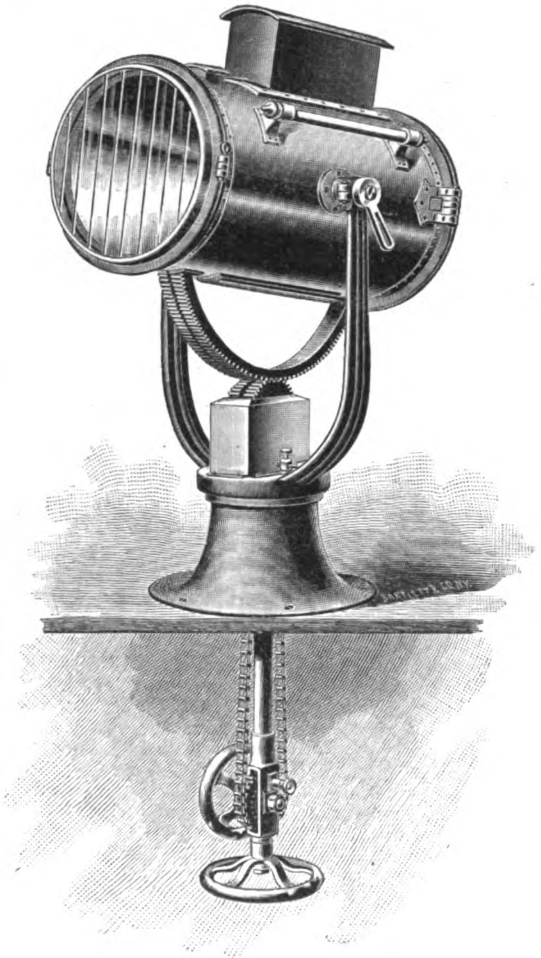
The necessity of a means of stopping electric motor cars instantly has long been perceived, being, indeed, one of the chief means through which a car can be run at full speed as long as possible, so as to get real rapid transit. A device recently introduced to this end is the Genett air brake, manufactured by the Genett Air Brake Co., of 150 Broadway, New York, and 11–23 South Jefferson street, Chicago. This brake is of simple construction but is very powerful, and is easily operated. It has already been placed upon roads in this city, Buffalo, Paterson, Denver, etc., and most satisfactory reports are being made upon it.

THE WARD ARC LAMP.

The Electric Construction and Supply Co. of 18 Corllandt street, this city, have issued a handsome catalogue descriptive of the well-known Ward arc lamp and containing, besides, an interesting introduction on the evolution of electric lighting, and several pages of testimonials from well-known people in all parts of the country. The catalogue is beautifully printed by Bartlett & Co., and is illustrated by some remarkably fine wood cuts executed by the same firm.

The contents include excellent descriptions of the Ward arc lamp in its various forms, single, double, short, etc., both plain and ornamented in a number of attractive styles; street railway and alternating current lamps; special lamps for photo-engraving and focusing work, and for theatrical, stereopticon and ophthalmoscopic uses; and also of the search lights recently introduced by this company with so much success.

In this department as in every other, there is room for development, and the Electric Construction and Supply Co. have devised a special form of small search light, shown in the accompanying illustration. Such a light must not only possess sufficient candle power, with facility of concentration and penetration, but must present an attractive appearance, in keeping with the trim and finish of the craft upon which it is installed. It must also be easy to manipulate and hard to derange. A great many owners of small craft, especially pleasure steam yachts, want a small machine and apparatus, but they like to get out of it a light of candle power commensurate with many times their tonnage. The small "Ward" search light is not equal to the powerful projector of a large man-of-war, but it will be found far beyond expectation, giving a strong beam of immense range. This light works automatically. It is placed on top of the cylinder so that only the carbons with their rods pass into the cylinder. The condenser used is a concave ground glass lens, silvered on the convex side, with about 18 inch focus. This form of lens yields the greatest amount of light with a given current. The glass lens never tarnishes, and therefore needs no cleaning, yet always affords the same amount of light. The lamp and appurtenances are made entirely of finished brass It is so constructed as to be controlled from within the pilot house by means of the shaft as shown in the engraving. If need be, the fixtures can be removed and the light operated by handles on the cylinder. The larger search lights can be fitted with a lens similar to that used in the small search light.



New Ward Search Lamp.

PHILADELPHIA NOTES.

The Harrisburg Foundry and Machine Works has just taken orders for engines, boilers, etc., as follows: Steelton Electric Light & Power Co., two 150 h. p. Ideal engines, boilers, pumps, heater, etc., Wilkesbarre & Wyoming Valley Traction Co., two 250 h. p. Ideal tandem compound engines, boilers, pump, heater and everything comprising a complete steam power plant, Lalande & Grosjean Manufacturing Co., Harrisburg. two large smokestacks, several large filters from the New York Filter Co., and a lot of ammonia stills and retorts from the Harrisburg Pipe Bending Co.; The McFarland Printing Co., Harrisburg, a large tandem compound engine; the Chillicothe (O.) Electric Light & Power Co. a 150 h. p. tandem compound engine. In addition to this they have just received orders for a number of simple and compound engines of various sizes which they are building for delivery to their New York house to be used in plants which are in process of construction.

The Pennsylvania Electric Engineering Co. has contracted to furnish the Steelton Electric Light & Power Co. of Steelton, Pa., with two 1,000-light 2,000-volt National alternating self-contained generators, two 150 h. p. Ideal engines, three 100 h. p. return tubular boilers, steam pumps, friction clutches, etc., and are to erect two miles of pole construction. This is a new plant and will be started within 60 days. An arc machine will be added to this plant in the spring.

The Commonwealth Electric Co. has closed a contract with the Geo. Manz Brewing Co., 6th and Clearfield streets, for a 125-light plant complete, a 100-light plant for Mr. Roland Smith, and a Howard watchman's clock for the Philapelphia Watch Case Co. The Commonwealth Co. make a specialty of repairing converters and rewinding armatures and fields. They keep several experienced men on this work alone.

WESTERN NOTES.

The Elkhart Converter is said to be making a splendid record for itself all over the Western country. The Electric Appliance Company who are taking care of the Western trade report receiving a number of very large orders, and in fact the demand has been so heavy as to exhaust their stock, and make it necessary for the factory to run night and day.

Taylor, Goodhue & Ames, the new Chicago electrical supply dealers, have been appointed general selling agents for the Columbia incandescent lamps manufactured by the Columbia Incandescent Lamp Co., of St. Louis. They are already booking some nice orders, and business is coming in in a way that exceeds all their expectations.

Mr. Jean A. Wetmore, of the Okonite Co., was among the well-known electrical visitors in Chicago last week. Mr. Wetmore, as an exponent of the advantages of using Okonite, is known from Maine to California, and his persuasive eloquence is something not to be forgotten.

The Sebastian Lathe Co., of Cincinnati, Ohio, have been driven by increase of business to remove to a large three-story factory building on Culvert and Harrison streets, where, with increased facilities, they will be able to meet every demand for their admirable tools promptly.

Washington Carbons.—The sales of Washington carbons by the Central Electric Company, who are Western agents, during the past week have been very large, and the Central can be congratulated upon carrying the goods in stock and giving their customers ready shipments.

Mr. Horatio S. Conner has been appointed superintendent of the Consolidated Electric Lighting Companies of Minneapolis. Mr. Conner will have charge of all three of their stations.

Mr. Frank B. Rae, the well-known electrical engineer of Detroit, was visiting in Chicago for a few days and was a caller at the Western office of **The Electrical Engineer.**

E. A. Armstrong Co., of Detroit, are going to install 600 incandescent and a few arc lights on incandescent circuits in their new factory at Evergreen Park, near Chicago.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

VOL. XIV. OCTOBER 12, 1892. No. 232.

THE ELECTRIC HOISTING PLANT OF THE DENVER PUBLIC WAREHOUSE

BY

Lewis Searing

PROBABLY the largest electric hoisting plant for warehouse purposes thus far installed is that of the Denver Public Warehouse Company, of Denver, Col. The progressive policy of the Warehouse Company led them at the outset to adopt electricity as the motive power for the building, but the local electric light company (of which there is but one), who were to furnish the current, soon showed them that it would not be profitable to any one but the electric light company. The Warehouse Company then had their engineer draw up plans and specifications for a complete steam plant, and various propositions from local isolated plants to furnish the required power were entertained. The electric light company, in the meantime, thought it over and finally made a proposition which assured the Warehouse Company of a reasonable return on their investment.

Power is supplied from the 3-wire motor circuit of the Denver Consolidated Electric Company, current for which is generated at their West Denver station, two miles distant, by two 80 K. W. 250-volt Edison generators, giving 500 volts at the switchboard of the warehouse. Charges for power are made on the meter basis, with a minimum rate, per 746 watts delivered at the warehouse, as measured by a Thomson wattmeter.

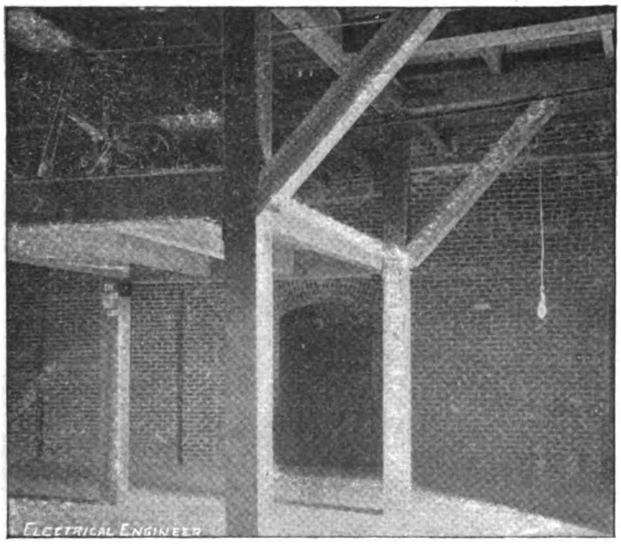


FIG. 1.—PLATFORM AND HOIST IN SECTION 2.

The plant is laid out for 10 hoists geared to six K. W. electric motors, and two freight elevators, operated by 15 K. W. motors. The present plant comprises four of the hoists and the two freight elevators, with switchboard and wiring complete for the full equipment.

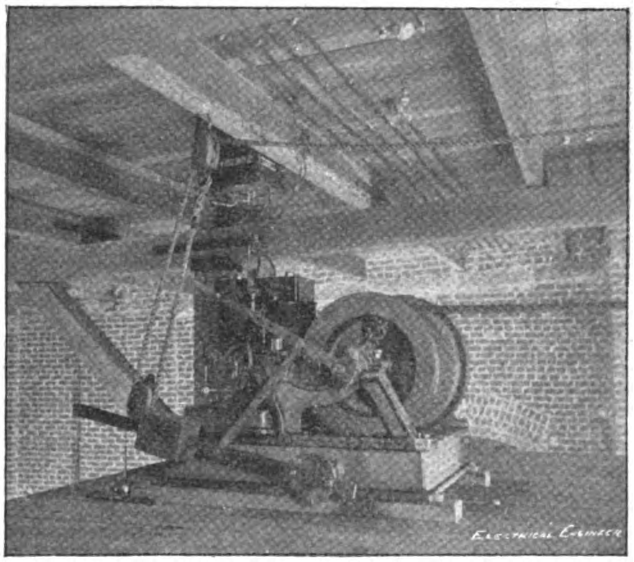


FIG. 2.—VIEW OF HOIST; SHOWING ARRANGEMENT OF TUBING.

The building, Fig. 5, is a substantial brick structure and measures 107 feet in width and 200 feet in length, with finished basement and four stories. The foundations are of solid masonry and the framing throughout is of the heaviest and most approved form of mill construction. The building is divided transversely into five sections 40 feet wide, by thick party walls, the only connection between the sections being through two openings in the party wall in each story, protected by fireproof doors. The warehouse is located at Nos. 50 to 70 Corbett street, a spur of the railroad approaching the rear.

The two elevators are so disposed as to admit of the speediest handling of heavy merchandise. Wide doors at the end of every section enable goods to be received into any portion of the building, either from the front or rear. The office occupies a portion of the first story of the first section, extending in length to the middle of the section and one-third of the section in width.

The architects of the building are Andrews, Jacques & Rantoul, of Boston, Chicago and Denver. The work was supervised by Mr. Clarence Gardner, their Denver representative. The entire scheme of the building indicates that it has been most successfully planned in regard to economy and facility of administration and also fire protection.

On the top floor of each of the five sections near both the front and rear doors, are erected platforms upon which stand the hoists. Fig. 1 shows the platform and hoist in the front end of section 2.

In the basement of the middle section and near the elevator shafts are located the motors and machines for operating the elevators. A wooden conduit of rectangular section, 24 inches wide and 1¾ inch deep is secured to the inside of the end wall of the building and extends from the rear end of the office to the upper part of the second floor where the conduit divides into two smaller conduits, 11 x 1¾ inches, running horizontally to the front and rear of the building, finally rising again and terminating under the roof at the points in line with the two rows of hoists. A similar conduit, 12 x 1¾ inches, extends from the office to the basement.

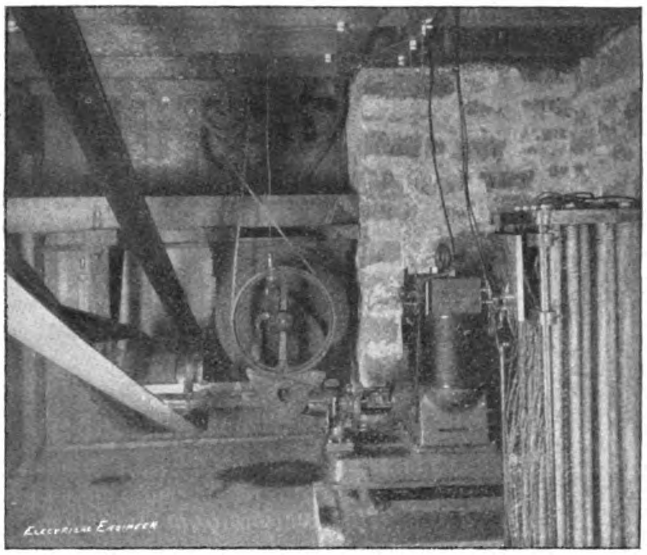


FIG. 3.—ELEVATOR MACHINERY IN THE BASEMENT.

In these channels are placed the insulating tubing of the Interior Conduit and Insulation Company, containing the necessary wires for ten motor circuits on the top floor and for two motor circuits in the basement. Twelve tubes and wires run to the top floor, two of which are used for the return. Three run to the basement, one of which is the return. Intersection boxes are placed at proper intervals in the tubing to facilitate the introduction or removal of wires, and terminal boxes are placed at the end of every circuit.

Emerging from the wooden conduit at the top floor the tubing runs along on the under side of the roof and is secured there by metal strips. Each tube terminates at its respective motor, except the return which leads by all, junction boxes being placed at each motor to admit of connection with the return. This arrangement of tubing is well shown in Fig. 2. The tubing in the basement is secured to the under side of the first floor and branches to the motors in a manner similar to that on the top floor.

Each motor is protected by a double-pole cut-out and a double-pole switch. Conveniently located near each motor are the starting rheostats, all of which are of the iron frame, non-combustible type. Those on the top floor have interposed between themselves and the roof a sheet of asbestos to prevent fire being communicated to the building should the rheostat become overheated.

The hoists, manufactured by W. A. Crooks & Co., of New York, are of the cone friction and band brake type, with winding drum 18 x 18 inches. The drum is mounted loosely upon a shaft carrying a friction cone, and is made to engage with the cone by a rapid pitch screw operated by a lever at the end of the shaft, which forces the drum along the shaft against the cone. The shaft is geared, by a double-reduction gearing, terminating in a raw-hide pinion, to the armature shaft of a standard 500-volt, compound wound Edison motor of 6 K. W., or 8.5 K. W. capacity, bolted to the base frame of the hoist,

The band brake is operated by a foot lever on the same side of the hoist as the lever operating the drum. The motors run continuously, the operations of hoisting and lowering being effected entirely by the hoist levers.

The hoisting rope used in this plant is 4½ inches circumference, four strand, "Stevedore" brand, manilla rope, with internal lubrication of plumbago; it is manufactured by C. W. Hunt & Co., of New York. The blocks, manufactured by the same firm, are of lignum vitæ wood, 16 inches in diameter, with steel roller bearings and are hung, not fixed, to the hoist beam, so that the block is always in line with the rope, reducing the wear on the rope to a minimum.

The hoists are arranged to be operated from any floor of a section by the simple pulling of a hand rope. The method of accomplishing this is shown in Figs. 1 and 2, and is as follows: The friction and brake levers are connected together by a link with an adjustable weight placed on the brake lever. A single hand rope, ¾ inch in diameter, of manilla, passes up through all the floors, leading over a pulley at the top floor to the hoist where it is connected through a system of blocks to the brake lever. The weight on the brake lever serves to keep a continuous tension on the brake band, which is sufficient to hold any load the motor is capable of lifting. When the operator pulls on the hand rope the weight is lifted, which releases the brake. The friction and brake lever being connected, this motion also moves the drum against the friction cone, but not enough to engage with the drum; the drum therefore unwinds from the weight of the load. A further movement of the hand rope, and consequently the levers, engages the friction wheel causing the motor to wind up the load. In the rapid handling of the hoist occurring in practice, the braking and hoisting is done entirely by the friction.

The 6 K. W. hoists are geared to handle a load of 500 lbs. at a speed of 300 feet per minute. They were tested to 850 lbs. The 8.5 K. W. hoists handle a load of 750 lbs. at the same speed and were tested to 1,200 lbs.

The freight elevators, two in number, are of the worm-geared belt factory type, manufactured by the Crane Elevator Co., of Chicago, having a capacity each of 5,000 lbs. at a speed of 50 feet per minute.

The question of space being one of considerable importance in a warehouse, the elevator machine was suspended from a frame-work of 8 x 8 inch timbers, to allow the traversing sheave to be placed entirely below the floor, thus confining all the elevator machinery to the basement, as shown in Fig. 3. Upon a foundation of concrete capped with Fort Collins stone, at the base of the elevator shaft, stands the 15 K. W., 500-volt compound Edison motor. The motor carries a pulley 9 inches in diameter with 10-inch face, which belts up to a 36 inch pulley on a countershaft overhead running 287 revolutions. A 29-

FIG. 4.—THE OFFICE AND SWITCH BOARD.

inch pulley on the other end of the counter-shaft belts back, by a straight and crossed belt, to the 14-inch pulleys of the elevator machine, running 325 revolutions per minute. This part of the plant has its exact duplicate at the other elevator shaft.

The elevator motors and counter-shafting are kept running continuously, the operation of the elevators being controlled entirely by the shipper motion on the elevator machines. Although a large amount of space could have been saved by the use of a motor coupled direct to the worm shaft of the elevator machine, this method was adopted as being the one which would give longer life to the motors, and do away entirely with sparking commutator and burnt rheostats.

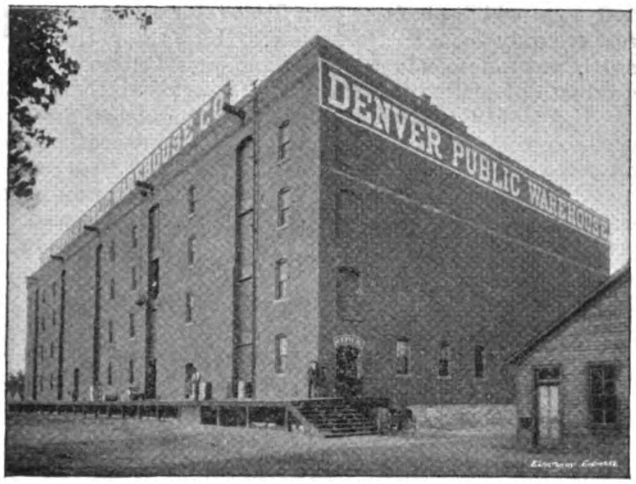


Fig. 5.—The Warehouse; Showing Hoist in Operation.

The switchboard, illustrated in Fig. 4 is located in the rear end of the office, is 5 feet high and 10 feet long, built up of three slate slabs, 1 inch thick and mounted in an iron frame of 1½ x 2 inch angle iron set out two feet from the wall. Each circuit is fed from the bus bars through a spring switch and an Edison ammeter. A double-pole "Ajax" switch at the centre of the board controls the whole system. The fuses for each circuit are on the back of the board. Completing the electrical equipment of the building are 104 incandescent lights supplied from the city circuit, a system of electric call bells throughout the building; and a watchman's clock and a special fire-alarm connected with the city fire department.

The officers of the company are: H. R Wolcott, president; C. G. Codman, vice-president; J. L. Jerome, secretary and treasurer; R. J. Freeland, superintendent. The power plant was designed and installed under the personal supervision of Messrs. Shepard and Searing, mechanical and electrical engineers, of Denver, Col.

THE PROTECTION OF METALLIC SURFACES.

By producing a thin layer of magnetic oxide of iron upon articles of wrought or cast iron, their surfaces may be preserved from atmospheric deterioration. This fact has been known for some time. Mons. P. H. Bertrand, however, has recently applied it as follows: He coats the surface of the iron or steel by electro-deposition with some metal or alloy which is capable of being volatilized at a temperature of 1,000° C. The article, or portion of machine, for example, is then introduced into a furnace heated to the required temperature. The iron becomes oxidized, but only to the magnetic oxide stage, and the metallic coating volatilizes, the operation being complete in a few minutes.

THE GENESIS OF THE MODERN DYNAMO: ANTONIO PACINOTTI.—IV.

(*Conclusion.*)

BY

Franklin Leonard Pope

In 1869, M. Zénobie Théophile Gramme, of Paris, a native of Belgium, by occupation a pattern-maker, designed and constructed the first of the magneto-electric machines with which his name has since become identified. His invention was patented in France,[1] in Great Britain,[2] and in the United States.[3] At a meeting of the Academy of Sciences, of Paris, on July 17, 1871, Gramme's machine was presented by M. Jules Jamin, and its performance elicited the warmest commendation from the members of that learned body. We give an extract, in translation, from the paper of M. Jamin read on this occasion, as published in the transactions of the Academy.[4]

Mr. Jamin, after calling attention to the well-known experiment of exciting an electric current in a closed helix by thrusting a bar magnet through it in the direction of its axis, said:

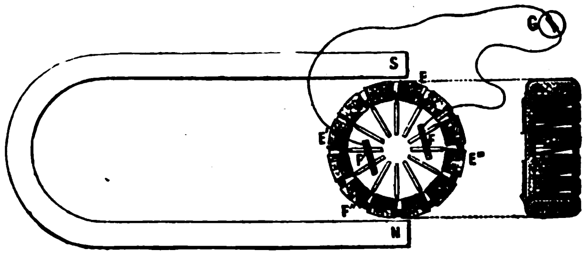
[TRANSLATION.]

This experiment leads to the idea that by making use of proper mechanical expedients it is possible to obtain an apparatus capable of furnishing continuous currents indefinitely.

Suppose that the electromagnet, instead of being a rectilinear bar, takes the form of a ring E E' E'' E'''. Place this ring under the simultaneous influence of the north and south poles of a horseshoe magnet N S, and suppose it to revolve about its own axis in the direction indicated by the arrows.

The south pole will produce in the adjacent part of the ring an electric current, the direction of which may be determined either by direct experiment or by theoretical considerations. It is apparent that the north pole produces in its neighborhood a current of opposite direction to the preceding one, and, also, that in the two parts of the ring at right angles to each other (which we may call *the lesser portions*) no current is produced. If, then, we wish to collect the two opposing currents produced simultaneously in the wire of the ring-magnet, we must place two corresponding collecting brushes at the lesser portions, which constitute the terminals of this new type of pile.

It is proper to give some details as to these brushes, which have been used heretofore, and are on the machine placed before the Academy. If the wire wound upon the ring is very thick, and if only a single layer of turns is placed upon the ring—a construction which will answer for some experiments—it is sufficient to bare the wires in a line and to establish brushes pressing upon the bared points. But if a greater length of wire is used, and if a greater number of layers are wound upon the ring, it is necessary to proceed as follows: Place a certain number of turns, three hundred, for example, in a series of separate windings upon the ring, then connect the wire to a piece of insulated brass, upon which the brushes press; then, without breaking the wire, continue to wind upon the ring three hundred more turns, forming a new series, attaching the end to a second piece of brass adjacent to the first, and so on. In this manner the wire wound upon the ring forms an endless conductor divided into a certain number of equal parts the junction points of which are soldered to insulated metallic pieces of a strength and shape to resist prolonged friction. These pieces of brass (commutator segments), placed



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[1] No. 87938, Nov. 22, 1869.

[2] No. 1668, of June 9, 1870.

[3] No. 120057, of Oct. 17, 1871.

[4] *Comptes Rendus*, lxiii, 175 (1871).

like radii upon the side of the ring, are represented in the figure. The brushes, F, press upon several of them. It is easy to see that two magnets instead of one may act upon the same ring, that is to say, four magnetic poles, or even a greater number, may be used. It goes without saying that a brush is always necessary between each two successive poles, and consequently as many brushes are necessary as there are poles.

It is possible to substitute in place of the permanent (field) magnet electromagnets which are excited by part of the current from the machine itself, following the well-known method; at the beginning of the movement the residual magnetism induces a feeble current in the ring; part of the current serves to excite the field-magnets, and the machine soon reaches its full power.

The machine submitted to the Academy is of this kind; it has two electromagnets, and, consequently, four poles which act upon the ring. It has four brushes, two of which conduct half the current into the field magnets, while the other two furnish the external current. On each arm of the electromagnets are wound seven kilograms of copper wire three millimetres in diameter. The ring is fitted with 200 metres of wire, two millimetres in diameter, weighing about seven kilograms.

The machine is driven by a fly-wheel operated by a man. It is capable of decomposing the water in a voltameter, of heating red hot and fusing 25 centimetres of iron wire nine-tenths of a millimetre in diameter, while if the ring be turned slowly the needle of a galvanometer, coarsely made of a single turn of wire, may be made to deflect. These effects become the more noticeable as the speed of rotation increases, until the maximum speed corresponding to 700 or 800 turns a minute is reached, which is easily attainable if the machine be put in motion by a steam engine. The effects, moreover, differ according to the characteristics of the wire wound upon the ring; effects of quantity are produced with a short, thick wire; of tension with a long, thin wire.

In a word, by means of this machine may be obtained every effect obtainable with the voltaic pile. There is, therefore, reason to think that it may be substituted for the pile with advantage in many cases both in industrial applications or in scientific research.

Immediately after the publication of this account of the Gramme machine, Dr. Pacinotti addressed a note to the editor of *Comptes Rendus*, which appeared in that journal as follows :[5]

[TRANSLATION.]

ON AN ELECTROMAGNETIC MACHINE CONSTRUCTED IN 1860 UPON THE SAME PRINCIPLES AS M. GRAMME'S MACHINE.

[Extract from a letter of Mons. A. Pacinotti to the Perpetual Secretary.]

(Referred to the Department of Physics.)

PISA, 20th August, 1871.

I find in the *Compte Rendu* of the proceedings of July 17, 1871, a note by M. Gramme upon an electromagnetic machine for producing continuous currents, constructed upon the principle of the transverse electromagnet, which I employed in 1860 in the construction of an electromagnetic machine, and which I likewise used in producing a continuous induced current. I published at that time a note containing a description and even the drawings of my little machine, in Vol. xix of the journal *Nuovo Cimento*. I send you a copy of this note asking you to be kind enough to present it to the Academy in support of my claim.

I do not contend with M. Gramme for the merit of having discovered the principle of the transverse electromagnet, by placing about it more than two influencing poles, but I desired that it should be clearly stated that the revolving electromagnet, provided with a commutator within the influence of the poles of a fixed electromagnet, had been constructed by me as far back as 1860; it produced a continuous induced current, indicating by the galvanometer considerable strength while passing through a voltameter. My machine is still preserved in the Cabinet of Technological Physics at the University of Pisa.

The foregoing account of Pacinotti's researches has been gathered in considerable part from a memorial prepared by him for presentation to the jury of the Turin Exposition, which has been supplemented by many additional particulars of interest gathered from his own lips. In it we read again the story of one of the master minds of experimental science; we see the painstaking, intelligent young student of nature's mysteries. Theory leads to experiment; experiment suggests new theories; the ever-ready note-book is at hand for the recording of every result, however apparently insignificant or unimportant; and thus day by day a deeper insight is reached; a more comprehensive grasp of the subject is gained, and at length the coveted result is brought to pass. Such a mind is surely not unworthy to be accorded a place in the front rank of the experimental philosophers, investigators and discoverers who have made the history of electromagnetism so illustrious, and of which Faraday, Henry and Joule have been such distinguished examples.

Antonio Pacinotti was born in Pisa, Italy, in June, 1841, and hence, at the time of the commencement of his researches in electromagnetism was but seventeen years of age. He had not, in fact, completed his twentieth year when he constructed the machine which has been described and upon which his fame as a discoverer and inventor will rest securely for all future time. His father, Luigi Pacinotti, was a descendent of a prominent Italian family, a graduate of and subsequently Professor of Mathematics in the University of Pisa, and was a distinguished mathematician and physicist. The younger Pacinotti, at an early age, manifested an inherited predilection for mathematical and physical studies, in which he was greatly encouraged and assisted by his father. He served with credit as a volunteer in the Corps of Engineers in the Austrian war of 1859, after which he returned to Pisa and prepared himself for examination for entering the university, receiving his degree with honors in 1861. In May, 1862, he became Assistant Professor of Astronomy in the Royal Museum of Florence, where he continued until December, 1864, when he received the appointment of Professor of General and Applied Physics in the Royal Institute of Technology of Bologna. In March, 1873, he was appointed Professor of Physics in the University of Cagliara. At the Universal Exposition in Vienna, in 1873, he exhibited the little continuous current machine made by him in 1860, which had, meantime, been carefully preserved in the Physical Cabinet of the University of Pisa, and he here received the first formal acknowledgement of the scientific world of the merit of his discoveries in the shape of a Medal of Progress. At the Paris Electrical Exposition of 1881 Pacinotti again exhibited his machine of 1860, together with some later forms of application of the same principle which he had devised, for which he received from the jury of awards a diploma of honor.

Professor Luigi Pacinotti.

Mr. Hiram S. Maxim, the well-known American inventor, who visited the Paris Exhibition of 1881, made a careful examination of the machine exhibited by Pacinotti, and sums up his observations as follows :

Three machines are exhibited, one of which is the original machine of 1860, as shown in various publications. The second machine has substantially a Siemens armature, a Gramme commutator and field magnets resembling those in Farmer's old machine. The brushes are of wire, two on each side, and the machine in general seems to contain all the features of the Siemens machine of that date. The armature is of solid iron, cut like a pinion, its projecting teeth passing close to the poles of the field magnets. * * * The apparatus is mounted on a wooden frame and is driven by a hand wheel and belt. The third machine has its field magnets set in a position similar to those of the Wallace machine. On the sides of the armature are polar projections like those of the Brush machine. All the polar projections are enclosed in a square wooden frame, and are in form like those of the Heikel machine. The commutator is of iron, similar to Gramme's, and the winding of the armature appears to be annular and spiral, but cannot be clearly seen. The brushes are of fine wire curved inward, and have a box above them for containing water or oil. The field magnets are cylindrical in form.

The striking resemblance between the little machine of Pacinotti and the more recently invented machines of Gramme, excited much comment among visitors to the Exposition and led many a spectator to ask himself how it could have happened that the former had remained so long, as it were, completely forgotten. The explanation of this anomaly, however, is not far to seek. In the original memoir of Pacinotti the apparatus is described as having been primarily designed as an "electromagnetic machine" or engine. But the scientific world had at that epoch in the progress of the art, and very properly, reached the conclusion that until some new and economical source of electricity was rendered available, it was not worth while to pay much attention to the improvement of machinery intended to utilize electromagnetism as a motive power. As to Pacinotti himself, as our account of him shows, he was essentially an investigator and discoverer, and hence it may be conceded that it does not in the least detract from, but rather adds to the degree of credit due him, that he took no steps to patent or to promote the industrial utilization of his discovery with a view to his own advantage. In his cast of mind, as well as in his methods of investigation, Pacinotti strongly reminds one of Faraday, and it was no less a philosopher than Faraday who said: "I have rather been desirous of discovering new facts and new relations dependent on magneto-induction than of exalting the force of those already attained, being assured that the latter would find their full development hereafter."[6]

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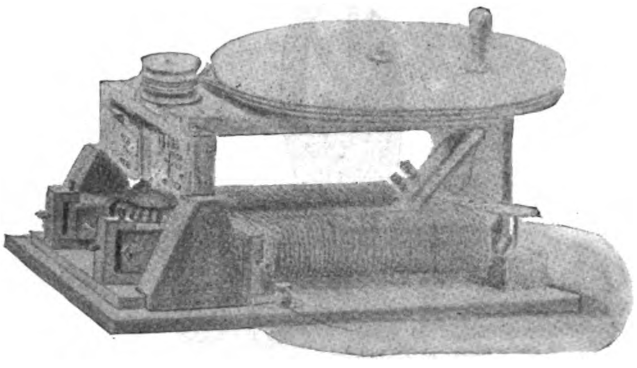
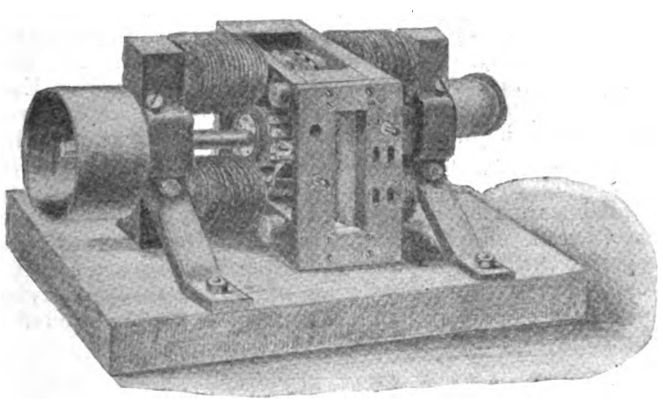
[5] *Comptes Rendus*, lxiii, 543-4 (1871).



Pacinotti's Machine with Siemens Armature.

(From an original pencil Sketch by Mr. Hiram S. Maxim.)

Professor Pacinotti has been a not infrequent contributor to the scientific and technical periodicals of his native country. Perhaps the greater number of these miscellaneous papers relate to electrical investigations, but the sciences of astronomy, solar physics and mathematics have received more or less attention at his hands.



Pacinotti's Machine with Double Field Magnet.

(From an original pencil sketch by Mr. Hiram S. Maxim.)

For much of the hitherto unpublished material embodied in this article, the author takes pleasure in acknowledging his indebtedness to Mr. Charles A. Terry, of the Westinghouse Electric and Manufacturing Company, who visited Pisa in 1891, and obtained directly from Professor Pacinotti himself, and from other authentic sources, much valuable matter, which has been freely placed at my disposal. Of the two interesting photographic portraits of Professor Pacinotti, which have been reproduced, that published last week represents him at the age of twenty-three, when Assistant Professor of Astronomy in the Institute at Florence, while the one given on page 259 is from a negative made in Florence about ten years ago. We also give a reproduction of a portrait of his father, Professor Luigi Pacinotti, made in Pisa many years since. I also wish to acknowledge my indebtedness to Mr. C. O. Mailloux for his kindness in making an admirable translation of the original papers of Prof. Pacinotti referred to from time to time in this series of articles.

INSULATED ELECTRIC CONDUCTORS.[1]—XI.

BY

James Bowstead Williams MAE.

It is not to be supposed that the following articles can give exact directions for the manufacture of insulated electric conductors, such as would enable the amateur to produce insulated wires equal to the best now made and in use, for the successful manufacture of such wires requires the experience which only practice can give.[2] All the writer has aimed to do is to give a general idea of the processes and machinery used in the insulation of wires, thereby enabling the general reader to form an intelligent idea of this most important branch of electrical engineering.

Magnet Wires.—These wires are the simplest forms of insulated electric conductors, and consist of copper wire covered with cotton or silk fibre, the fibre being unsaturated with any insulating material. They are used in the construction of electromagnets, induction coils, armatures of dynamos, etc. They are made by winding one or more layers of the fibre, in the form of yarn, upon the wire by means of upright or horizontal winding machines. An ordinary upright winding machine consists essentially of a horizonal revolving platform upon which any suitable number of spools or bobbins containing the yarns are loosely mounted upon fixed, upright standards; means for drawing the wire perpendicularly through the centre of the platform; devices for regulating the tension and laying of the yarns; the whole being secured in a strong metallic framework provided with the necessary gearing, pulleys, etc. Such a machine will wind but one layer at a time. If more than one layer is desired they are best applied by means of a double or triple winder. In these machines the platforms, provided with bobbins, etc., revolve in opposite directions, thus causing the spirals of each layer to cross those of the layer immediately beneath it, and forming a more satisfactory covering for the wire than if the spirals of the different layers all had the same direction.

If the cotton and silk are perfectly clean and dry, the silk-covered wires will be better insulated than the cotton-covered; and, as the fibre of the silk is finer than that of the cotton and lies closer to the wire, more of the silk-covered wire can be wound in a given space.

While the silk-covered are more expensive than the cotton-covered wires, and better, still, for ordinary purposes, the latter will be found to be sufficient, provided that the cotton is perfectly clean and dry and is kept so. If the best results from the silk-covered wires are required, *white* silk should be used in preference to the green, for the dyeing material in the latter is nearly always detrimental to the highest insulation.

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[6] *Experimental Researches*, ii, 168.

[1] *Copyrighted* 1892, *by J. B. Williams.*

[2] The consideration of insulating material proper will be discontinued for the present, and the manufacture of insulated electric conductors at once entered into; but items of importance relating to insulating material will be inserted whenever necessary.—Eds. E. E.

Magnet wire, as such, should only be used to convey weak currents. Its special use is in cases where induction should be kept as low as possible, as in the coils of reflecting galvanometers. In cases where it is not advisable to saturate the fibrous covering after the wires have been placed in position, as in galvanometer coils, the fibre should, if possible, be thoroughly dried and then protected by some form of moisture-proof covering. Silk, cotton, and other vegetable fibres are very hygroscopic, and absorb moisture quite rapidly if, after having been dried, they are exposed to a damp atmosphere. The writer has conducted many experiments upon fibrous-covered wires, especially cotton-covered, and found that this material absorbs moisture in less than ten minutes when thus treated. When cotton is dry and free from gummy and other foreign matters its specific resistance is high; and it continues to have this high resistance as long as it is *kept* dry. But just as soon as the fibre begins to absorb moisture this high resistance begins to decrease, and continues to decrease as the absorption progresses. A damp fibrous covering is but little better than no insulation at all.

The saturation of the fibrous covering of electric wires will be considered later.

Painted Wires.—These consist of electric conductors covered with fibrous material, usually cotton, saturated with paint. Fireproof and weatherproof wires belong to this class. Such wires are used mainly to convey strong currents, particularly those for the transmission of power and electric lighting. They are made either by forming two or more braids of the fibrous material upon the wire and then soaking the braids with paint, or by soaking the threads or yarns in paint as the braid is formed by a braider. A braider, a cut of which is shown in Fig. 1, resembles the upright form of winder in its general appearance, but in this machine there is no revolving platform to carry the bobbins around the wire. The bobbins are loosely mounted on upright standards, each of which is provided with an elliptical base, on the under side of which is a projection. The stationary platform of the braider has continuous and communicating slots, resembling the figure 8, formed in it in which the projections move. By means of specials gears under the platform these projections are caused to move around the wire which passes through the centre of the platform, but in a serpentine course. One-half of the bobbins pass around the wire in one direction and the other half in an opposite direction; and owing to the peculiar motion of the bobbins each thread is caused to pass alternately over and under the adjacent threads, thus forming a braid at the intersection of the threads. Each braider is provided with mechanism for drawing the wire upwards as the braid is formed upon it, and for operating the machine by hand while threading it; also devices for regulating the tension of the threads, and for instantly throwing the machinery out of gear upon the breakage of the thread. Each bobbin may carry from one to three separate threads. Double and triple braiders are used for forming a covering consisting of two or three overlying braids at one operation. A view of a double braider is shown in Fig. 2.

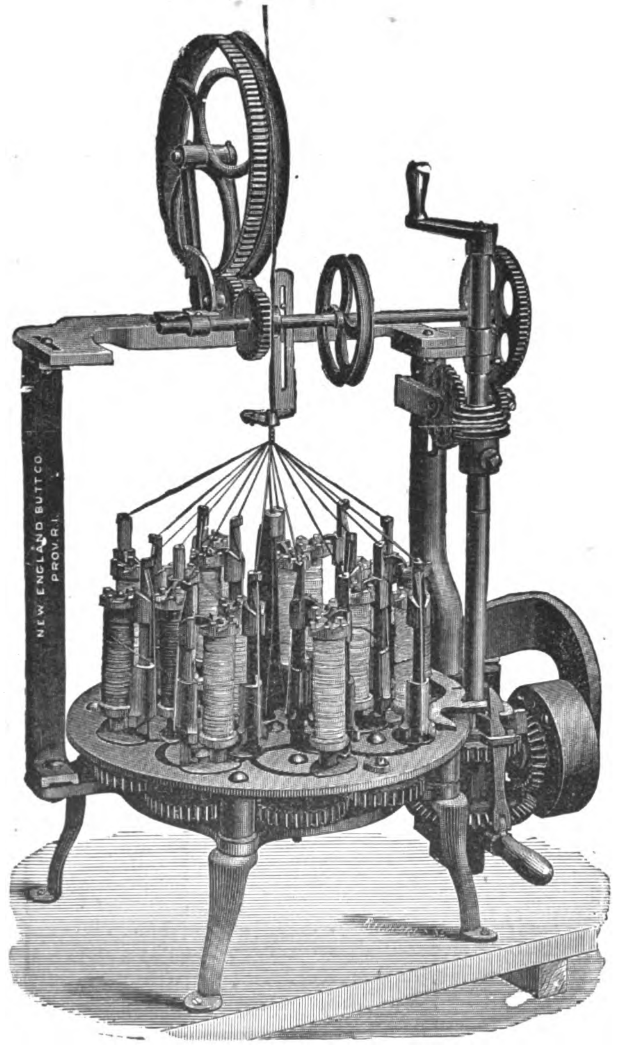

NEW ENGLAND BUTT CO.
PROV. R.I.

Fig. 1.—Single Braider.

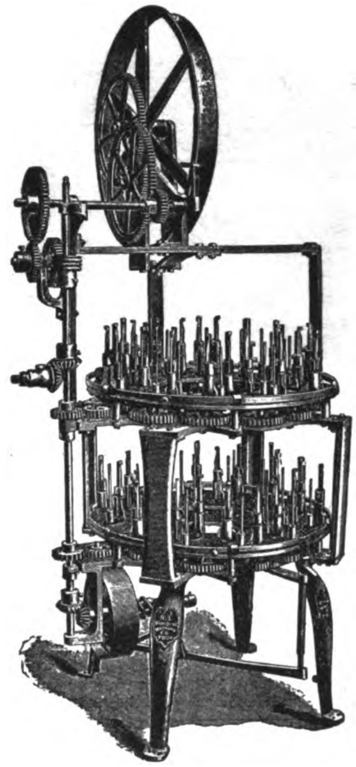


Fig. 2.—Double Braider.

INCORPORATION.

The Nassau Electrical Manufacturing Company has filed articles of incorporation with the county clerk at Elizabeth. The incorporators are Andros B. Stone and Philip Hathaway of New York City, William D. Marvel of Flushing, L. I., and M. S. Rosenweig of Springfield, N. J. The capital of the company is $70,000, and its plant will be in Springfield, with the main office in New York.

SELECTORS FOR ELECTRIC CIRCUITS.

BY

Henry E. Vineing

SELECTORS are electrical instruments connected in series in a circuit, each instrument being arranged so that it responds to a certain combination of electrical impulses, such combinations of impulses being imparted to the circuit either mechanically or automatically at one point on the circuit. This enables an operator at one point to perform work indirectly at distant points. All that is required of the selector is that, after responding to its prearranged combination of impulses it closes a local circuit or circuits at the point at which such selector is placed. When the selector has done this it is possible by the intervention of electro-mechanical devices to perform a variety of work, such as ringing a call bell, turning a switch to start or stop electric lights, machinery, motors, etc., or even operate the valve of a steam engine or pump. Up to the present time the instruments invented for this purpose, as a rule, have been complicated and expensive. And on account of the principle on which nearly all have been constructed mechanically, have met with limited success in practical operation.

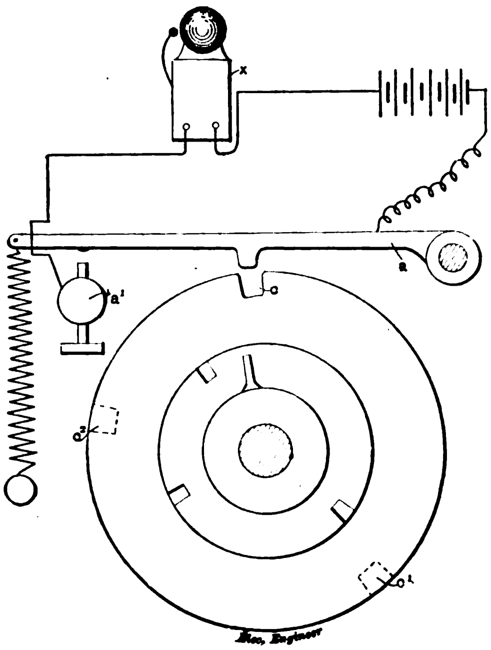
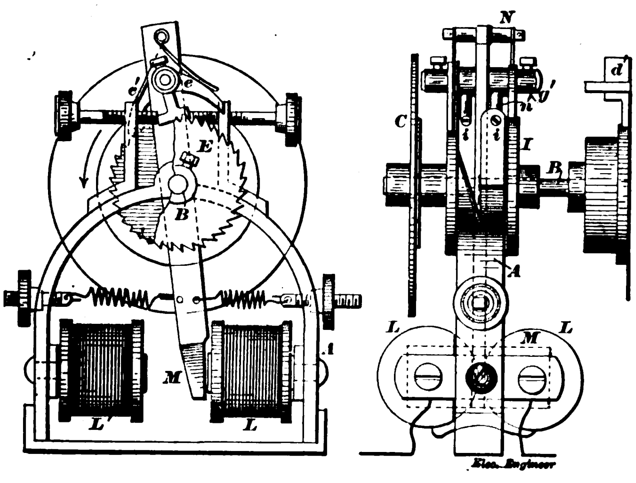


FIG. 1.—THE VINEING SELECTOR.



FIGS. 2 AND 3.—THE VINEING SELECTOR.

After studying the subject for some time I designed a selecting instrument which is a radical departure from previous methods and which is here described for the benefit of inventors who are grappling with the subject at the present time and also for the information of those interested in electrical development.

It occurred to me that the principle of an ordinary combination or safe lock which is operated, as all know, by a graduated dial rotated to certain positions to the right or left, could be applied. Thus by bringing the slots c, c^1, c^2, Fig. 1, in the discs or tumblers enclosed in the case, into such a position that the bolt, being impelled by a spring, drops into them the door can be opened.

Referring to Fig. 1, A represents a lock with three discs which are shown in position when the lock is closed, B, representing the same when open. To adapt the lock to the purpose required, contact arms a, a^1, are arranged, as shown. To these are connected the pawls, e, e^1, Figs. 2 and 3, which are attached to the upper end of the armature M, and which engage the ratchet wheels E, respectively. The shaft B being connected to the dial of the lock enables us to rotate the dial to any position either to the right or left and make any combination desired. A number of these instruments being connected up in series as in Fig. 4, with transmitting key A in circuit, I set all the instruments at zero. By sending impulses on the line I operate all the instruments, and, all being synchronous, all the dials are moved exactly alike and will be in the same relative position.

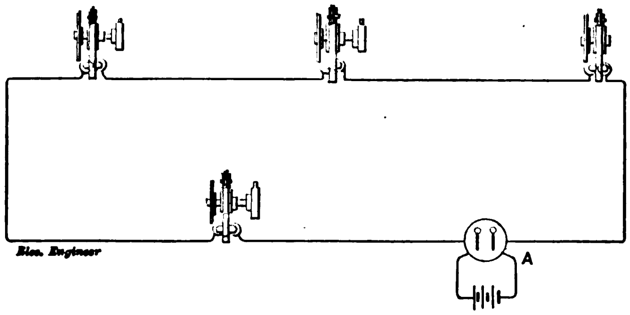


FIG. 4.—THE VINEING SELECTOR.

It is easily seen, therefore, that to operate any instrument, all that is necessary is to transmit impulses which will bring the dials to such positions as before described so as to make the combination of the lock required. Each lock being of a different combination that lock only will work, or circuit arms e e^1, Fig. 1, will be brought together only on the lock whose combination responds to the impulses given on the transmitting device.

The apparatus described is simple, cheap, and as infallible as a safe lock.

A NEW CURRENT REGULATOR.

MR. GUSTAV CONZ, of Hamburg, has devised a maximum-current regulator. Its object is to prevent an increase of current over a certain maximum pressure—not as an ordinary lead fuse which completely breaks the circuit, but it renders possible the further passage of the current by the insertion of a resistance. It is proposed to use this device with batteries of accumulators, and in place of electricity meters in house installations.

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Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. XIV. NEW YORK, OCTOBER 12, 1892. No. 232.

The man who makes a real discovery and works it out is a benefactor who ought to be rewarded.—John T. Sprague.

WHAT IS THE EDISON LAMP DECISION WORTH?

OUR readers will by this time have read the extra number of THE ELECTRICAL ENGINEER issued last week containing the official text of the decision of the U. S. Circuit Court of Appeals upholding the Edison incandescent lamp patent. They are therefore familiar with the status of affairs, so far as the Courts are concerned, and to the extent of their knowledge of the questions involved. We believe that in the main they will agree with us in saying that it is genuine cause for congratulation that another patent has been sustained. The amount of capital invested in electricity, unprotected by patents, has hitherto been so small that it may be laid down as an axiom that every time an electrical patent is sustained the whole industry benefits in the eyes of the public. In this case, moreover, there is again a vindication of the claims to inventive genius of a man whom no detraction can belittle. Mr. Edison has made fatal mistakes. His blind and dogged opposition to the alternating current has been an extraordinary exhibition of insensibility to the signs and progress of the times. Yet, after all the criticism that can be brought to bear upon him, he remains a great and noble figure in the inventive field—the father of incandescent lighting—a Columbus of modern electricity.

But what shall we say of the commercial aspects of the decision? The situation is, indeed, strangely complex. This very decision, rendered last week, inures apparently to the benefit of those who, but a few months ago, were just as much infringers as those whom they may now, perhaps, feel disposed to crush out of existence. Nay, more, the present management of the General Co. includes the wonderful organizing powers that created hundreds of sub companies, nearly all of which, under their incentive, have violated this patent, while it was still in doubt, from the earliest days of their incorporation. In many cases, these sub-companies operate incandescent lamps to-day in territory where, under this patent, local Edison companies enjoy, and are in the temper to enforce, exclusive rights. How is such a situation to be harmonized, if the decision is to be upheld? Are these sub-companies to be deprived of lamps by the very hands that sold them generators on which to run the lamps? It seems hardly credible.

That this decision gives the General Electric Co. power to close up all outside factories that make the ordinary lamp of every day use, seems to us indubitable. The decision is plain, broad, unequivocal. It is a decision that no shrewd or honorable manufacturer would care to defy. But, as we have pointed out before, the protracted delay in bringing the lamp cases to final issue has been an adequate excuse for many to begin lamp making, and the courts have said this in so many words. One obvious conclusion, then, is that in a great many cases the present lamp factories are likely to continue under some arrangement, the terms being special, perhaps, in each case. There is unquestionably need for more lamp factories than one, if only to meet the local demands of various centres of consumption. But whatever arrangement is entered into, it seems to us that it will and must respect the exclusive rights of the Edison licensee local companies, which, again, outside their own territory, have nothing to say.

But the question arises whether we are to assume that the Edison incandescent lamp is the only possible commercial one at this stage of the art. It is an open secret that the Westinghouse Company has a lamp made with a stopper instead of an integral glass globe, and the lamp is reported to be highly efficient. Moreover, many of us have seen Mr. Tesla's brilliant experiments with his single-rod lamps and with lamps entirely free from filaments—"illuminated vacuums" merely. Such a decision as this, even in view of the short time that the patent has to run, is an immense stimulus to invention. We do not see, therefore, any narrowing of the field or of opportunity.

THE NEW WESTINGHOUSE LAMP.

OUR advertising pages contain a most important announcement from the Westinghouse Company, as to their new lamp referred to above. The points as set forth in the circular are: That the new lamp requires no platinum; that it is made in separable parts, so that the incandescent burner can be renewed and the bulb and other parts of the lamp used over and over; that by means of "an important discovery the burner is rendered stable, its efficiency increased, its life prolonged, and its normal candle power maintained;" that, as the lamp will be made almost entirely by machinery, the cost will be reduced and there will be a saving of from 30 to 50 per cent. on the expense to consumers for incandescent lamps for a given service, and that neither the Edison patents nor those of any other company will be infringed. The manufacture of the new lamp has been begun at the Westinghouse factory in Pittsburgh, and the circular says that the lamps will be delivered in quantities after Dec. 1. We understand that the patent protecting this lamp is an old Sawyer-Man patent.

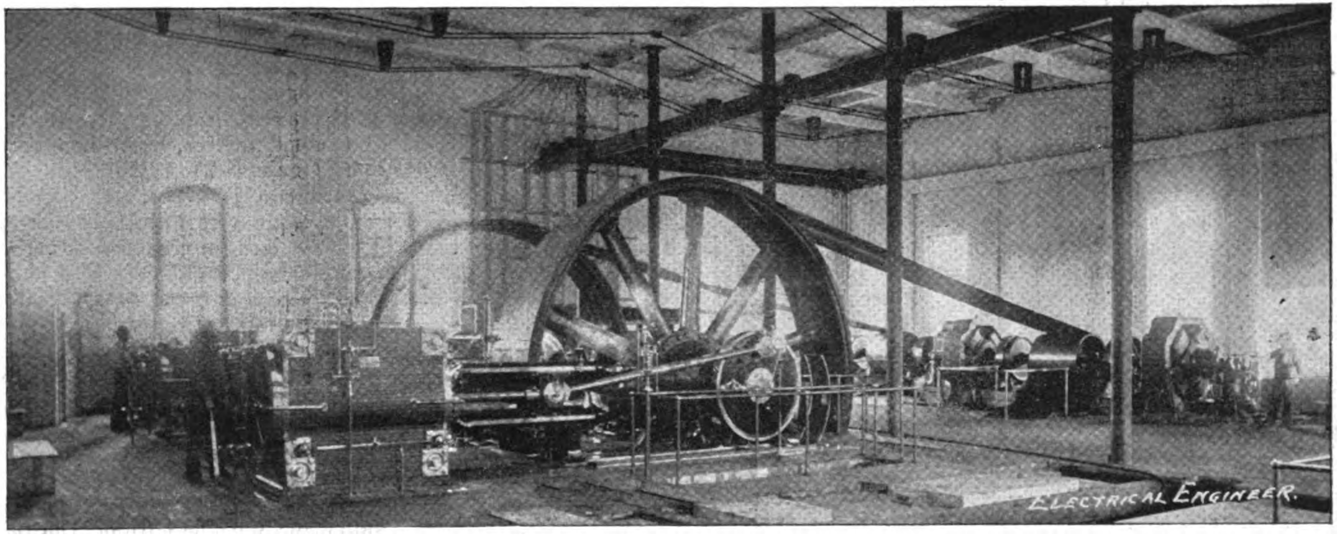
ELECTRIC RAILWAY DEPARTMENT.

THE NEW STATION OF THE LOWELL AND SUBURBAN STREET RAILWAY COMPANY, LOWELL, MASS.

BY

A. C. Shaw.

The history of the development of electrical railroading is one always full of interest to the engineer, and the different methods adopted by different engineers, must at all times serve as object lessons to those who are still contemplating changes. In The Electrical Engineer of October 21, 1891, it was my good fortune to be able to present to our readers a complete descriptive article—some 20 pages in length—on the power house of the West End Street Railway Company, of Boston, where the engineers who designedthe plant, considered that a moderately high rate of engine speed and counter-shafting was necessary. Recently in the Engineer of August 10, a description of the new Boston Edison Station was given, where direct-coupled engines were used in a totally different type of station. Now it is my intention to describe the new station of the Lowell and Suburban Street Railway Company, of Lowell, Mass., where Corliss engines of moderately large capacity are *belted* direct to two generators driven by the same pulley and on the same shaft, making a 500 h. p. unit of one engine and two generators each of 200 kilowatts capacity.



The New Station of the Lowell and Suburban Street Railway Company, Lowell, Mass.

The history of the company, like most other roads, is one of gradual development, and a few details may be found interesting. The Lowell Horse Railroad was organized in April, 1863, with an authorized capital of $100,000 and a paid-up capital of $40,128, and enjoyed a monopoly of the carrying business till 1886, when the Lowell and Dracut Company was organized with a capital of $15,000, and operated at first the line on Lakeview avenue, later entering the city on Bridge street. In 1887 the company was chartered with a capital of $100,000, and later increased the capital stock to $200,000. In 1889 $100,000 bonds were issued for the purpose of making an electrical equipment for the line built to Lakeview, a very beautiful and popular summer resort about five miles from Lowell. In 1890 the Lowell and Dracut Company, and the Lowell Horse Railroad were each operating about 13½ miles of track, and on October 20, 1887, the directors of the Lowell and Dracut Company obtained a controlling interest in the Lowell Company. In June, 1891, a consolidation of the company was consummated and a new company organized bearing the present title, the capital stock being placed at $300,000. At that time electric power was hired from the Lowell Electric Light Company, but soon after the consolidation it was decided to use electricity exclusively, and the right to issue $1,000,000 of bonds was secured for the purpose of building the station to be described, and for the general electric equipment of the whole road. The general plans were placed in the hands Mr. William D. MacQuesten, of New York, the details of the work being afterwards faithfully carried out by Mr. George B. Damon. It was early decided to use condensing engines, and as the company owned ground on the banks of the Merrimac River, a location about one mile from the centre of the city was at last decided upon, and ground broken on October 5, 1891, the power being started on July 23 of the following year. The situation of the new power house was well and carefully chosen, there being ample condensing water, splendid coaling facilities, the Boston and Maine Railroad passing within a few feet of the boiler-room, and ample room for increase. When the vast system of contemplated increase is completed, the station will also be electrically central, and though at present there has been a considerable extra expenditure in wire, yet in a few years it will be situated in the most economical centre of operation.

THE BUILDING.

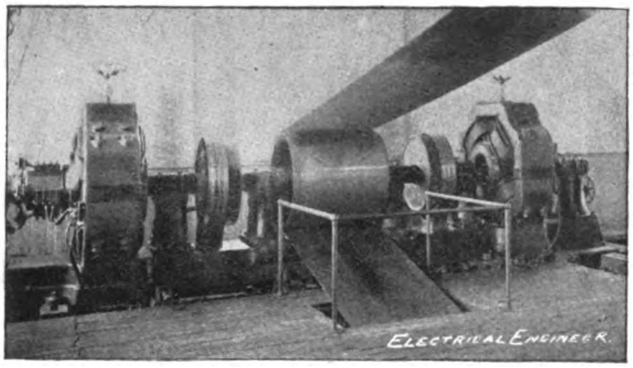
The building, a general plan of which is shown on page 347 measures 180 feet long by 125 feet wide, and is built of brick. The foundation walls, which are of granite, rest on a natural bed of clay and sand, on the average level of the Merrimac River, no concrete foundation nor piling being necessary. The bed stones are 5 feet wide and 18 inches thick, and on these rest the granite walls 3 feet thick at the bottom, tapering to 2 feet thick at the top, 13 feet above the clay. On top of the granite are the brick walls 16 inches thick with 4 inch pilasters on each side 10 feet apart, the roof girders all resting on top of the pilasters.

THE COAL STORAGE.

Next to the railway is the coal storage, shown both in the plan and elevation, which consists of a large room measuring 125 feet by 40 feet by 35 feet high from the concrete floor, and having a wooden bow-string girder roof. Furthest from the boiler-room side of this room, there has been erected a standard Boston and Maine Railroad trestle 8 feet above the level of the main track outside, and 18 feet above the concrete floor below, connecting with the Boston and Maine tracks at one end and extending about 70 feet beyond the coal storage room in the other direction. This room will have a storage capacity of 3,000 tons of coal, and communicates with the boiler-room, by means of two openings in each of which are provided Standard Fairbanks scales for weighing the coal consumed.

THE BOILER-ROOM.

The boiler-room measures 125 by 45 feet, by 42 feet high, and has a wooden monitor roof, with windows and ventilators, supported by bow-string girders. At present six return tubular boilers with overhanging front, have been installed, built by Messrs. Scannell & Wholley, of Lowell. Each boiler is of 250 nominal h. p. capacity, has a heating surface of 1,737 square feet with a grate area of 38 square feet, is 6 feet in diameter, 17 feet 6 inches long over all, and is fitted with 140 3-inch tubes 16 feet long. The boilers have a plain setting, and have a double wall, with a 2½-inch air space between the walls, and are intended to work at a pressure of 125 pounds. A wrought iron uptake conveys the smoke to the chimney and measures at the largest point 9 feet 5 inches by 3 feet 10 inches. In the boiler-room are situated two Deane steam pumps each large enough to supply all 12 boilers, the capacity of the boiler-room, with water.



THOMSON-HOUSTON DYNAMOS IN THE LOWELL STATION.

THE CHIMNEY.

The chimney rests on a pile foundation, 300 piles 25 feet long having been driven at 18-inch centres, on top of which is a granite foundation 10 feet high laid in Portland cement. The chimney is 195 feet high, is of circular section, and has two distinct walls all the way to the top. The outside wall is 20 feet 3 inches outside diameter at the bottom, and is 32 inches thick, tapering by 4-inch offsets every 35 feet, to 12 inches at the top where it has a diameter of 14 feet 6 inches, except at the cap where it is 17 feet 6 inches diameter. The inside shell is 9 feet 7 inches internal diameter and continues this diameter to the extreme top, the thickness of the shell being 20 inches at the bottom, tapering by offsets to 8 inches at the top. On top of the chimney is a cast iron cap, made in 10 sections, bolted together inside, and filled in with brick making a perfectly smooth appearance on the outside. The capacity of the chimney is 3,000 h. p., there being two boilers to each engine, and a spare set in case of accident.

STEAM PIPE.

From each boiler runs a 6-inch wrought iron steam pipe making a vertical bend and connecting with a horizontal wrought iron steam drum of 20-inch diameter, which is supported close to the wall, and runs across all six boilers. This drum is fitted with extra heavy steel flanges riveted together, and Ludlow valves are used entirely. From the steam drum runs a 7-inch steam pipe connecting with the engines, also making a vertical bend, so as to procure dry steam and allow for expansion and contraction. All the steam pipes and connections are covered with magnesia, supplied by Nightingale & Childs, of Boston.

THE ENGINES.

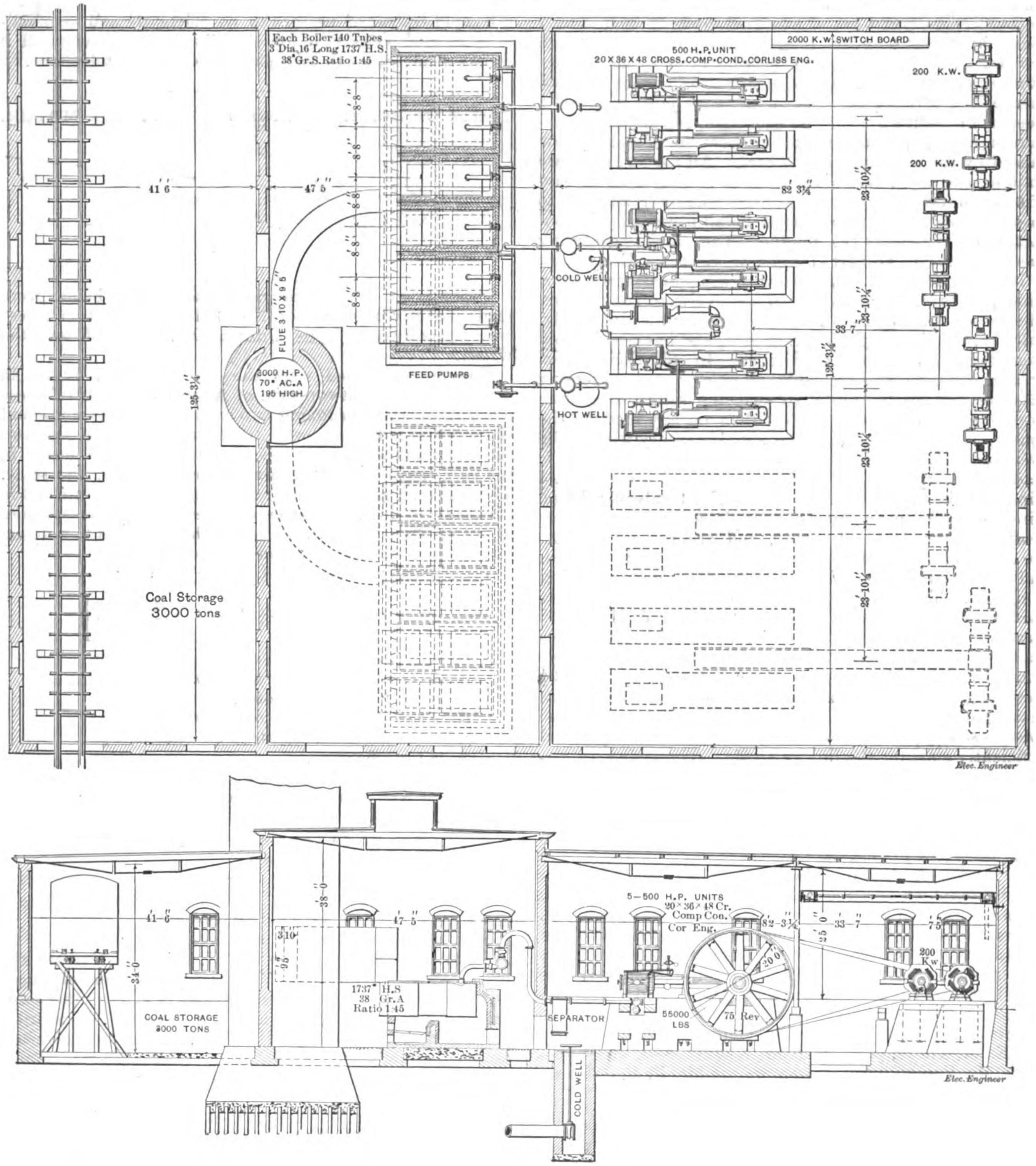
Cooper-Corliss engines have been adopted, manufactured by C. & G. Cooper & Co., of Mount Vernon, Ohio, two of which are at present running, and a third is now being installed. They are cross-compound condensing engines with cylinders 20-inch and 36-inch diameter by 48-inch stroke. The fly-wheel is 20-foot diameter, by 48-inch face, weighs 55,000 pounds, and makes 75 revolutions per minute. The cylinders are steam jacketed, and between the high and low-pressure cylinders is a multitubular reheater. In the basement of the building, each engine has connected with it a Deane 500 h. p. condenser and pump combined, and a 500 h. p. National feed water heater, made by the National Pipe Bending Company, of New Haven, Conn. The pipe connections between the cylinders of the engines and the condenser have been made in such a way that every possible way of running the engines may be attained, should any trouble arise with either the condensing or heating apparatus. For instance each side of the engine can be run high-pressure and exhaust direct into the atmosphere, with or without the feed water heater, or the engine can be run condensing with or without the feed water heater: in all nine possible combinations may be used, so that it is almost impossible for any accident to necessitate shutting down the engine, unless an actual break-down of the engine itself. The fly-wheel of the engine is belted direct to the pulley of the generators, a 46-inch double-ply belt manufactured by Josiah Gates & Sons, of Lowell, being used. The foundations of the engines are of brick 31 feet long by 8 feet wide by 9 feet deep, which rest on a solid granite foundation laid in cement 5 feet thick and extending 125 feet, the whole width of the building.

THE GENERATORS.

The arrangement of the generators is quite new, two 200-kilowatt Thomson-Houston generators being driven from the same belt, and situated on the same bed-plate, the pulley for driving them being on a shaft in alignment with the armature shafts and connected thereto by means of two Hill clutches, one for each generator. The bed-plate for the two generators measures 26 feet over all, and supports rigidly the bearings of the generators and the driving pulley. Each generator is fitted with self-adjusting and self-oiling bearings. Immediately under the bed-plate of the generators is a brick foundation 28 feet long at the top by 8 feet wide and 8 feet deep, which in turn rests on a heavy granite foundation resting on the clay, 30 feet long by 10 feet wide and 4 feet deep.

THE SWITCHBOARD.

The dynamo switchboard is of solid slate mounted on a skeleton frame of wood and is made in 10 sections, one for each generator. On each section is mounted two circuit breakers, one 650 ampere ammeter, one dynamo switch, rheostat and lightning arrester. All the connections are on the back of the board, and are made with clamps and screws. The feeder switchboard is also of slate mounted on a skeleton frame of wood, and is equipped with the Ajax switches with fuse attachments, manufactured by A. & J. M. Anderson, of Boston. The board is divided into eight sections, representing eight different sections of the city. Some of these sections have one feeder only, and some have two, three or four, according as the traffic is heavy or light in that section. Each feeder is provided with an ammeter and a 200-ampere Ajax switch, there being room on each section for four ammeters and four switches.



General Plan and Sectional Elevation of the Station.

OUTSIDE CONSTRUCTION.

Having thus described the power house, a few details about the outside construction will be found interesting, especially as there are some novel features, never before used on electric railway work. The general plan of the outside work was devised by Mr. P. F. Sullivan, the general manager of the company, from several years' experience with the Lakeview road. At present there are about 40 cars in operation; all being fitted with two 15 h. p. W. P. motors, mounted on Bemis trucks, and equipped with series multiple controllers. The track construction is all of the newest type, the Wharton 90-pound girder rail 9 inches deep, manufactured by William Wharton, Jr., & Co., of Philadelphia, being used. These rails are spiked direct on to the sleepers, which are of kyanized spruce, 5 inches by 7 inches by 6 feet 6 inches long, and laid on 2-foot 6-inch centres. The joints are connected by heavy fish plates fitted snug, and making a shoulder bearing for the rail, and then bolted with six bolts, and under each joint is placed a sleeper, in addition to one at each side, so that every precaution has been taken for the prevention of loose joints caused by the pounding of the cars. All the switches are trailing, and are 7 feet long, the cars having a wheel base of 6 feet 6 inches, so that it is impossible for any car to throw a switch, all four wheels being necessarily in contact at one time with the tongue. The track engineering was done by Mr. Gilbert Hodges, of Boston. Each joint is double bonded and connected with a supplementary wire, which, in turn, is connected to an overhead return wire. The use of this overhead return is new, and is due to Mr. Sullivan, who is greatly in favor of it, and has used it from ideas derived from past experience. In addition, sinkers or large ground plates are sunk in canals or rivers wherever they are met in the route, so that the return circuits in Lowell are to-day more perfect than on any road in the country. Connection from the supplementary wire to the overhead return, which varies from No. 0 to No. 0000, is made at every fifth pole. The track bonds are of No. 4 wire, and the supplementary wire is No. 1 galvanized iron wire. The wires connecting the supplementary to the overhead return are of No. 4 copper, and are run up through the iron poles. All the overhead wires are triple braided, and were made by the Washburn & Moen Manufacturing Company. The trolley wire is No. 0 throughout and is of hard-drawn copper, also made by Washburn & Moen and guaranteed 98 per cent. conductivity. Walworth poles made by the Walworth Manufacturing Company, of Boston, are used in the city, the No. 2 extra heavy size, 29½ feet long, being used, except at the curves where extra heavy poles are required. In the suburbs a Georgia pine pole is used in place of the iron pole as being cheaper and sufficiently good for the lighter traffic. The trolley insulators and clips are of the Thomson-Houston type, and the strain insulators and pole insulators are made of the well-known Ætna material, and manufactured by A. and J. M. Anderson, of Boston. The poles are thus doubly insulated from the trolley wire, first by the trolley insulator and then by the Anderson swivel pole insulator. The span wire is composed of three No. 8 steel wires, and the guard wires are made of No. 9 wire, being supported by two No. 8 wires. The whole work has been done in a first-class and substantial manner, and reflects great credit not only on the engineers but on the officials of the company, who have lent every assistance in their power and spared no expense to make their electric system as perfect as any in the States. The officers of the company are at present: Mr. E. M. Tucke, president; Mr. August Fels, vice-president; Mr. Percy Parker, treasurer; and Mr. P. F. Sullivan, secretary and general manager.

THE ELECTRIC RAILWAY vs. TELEPHONE IN GERMANY.

With regard to the electric street tramway at Halle, says the London *Railway World*, one very noteworthy and interesting fact to be commented upon is, that the tramway authorities have successfully fought and conquered in the customary pitched battle with the telephone interests, represented in this instance by no less a power than the German Government. However, the courts of law have maintained clearly that the use of an earth return as part of any electrical circuit is quite open to telegraphs, telephones, or electric tramways; and if one is found to interfere with another, then the latter must adopt a different method of completing its circuits than through the earth, if it desires a change at all. Such a decision appears to be given purely on public grounds; the idea apparently being that it is, at least, equally important for the rapid transit of persons to be efficiently and economically carried on as it is for the transit (we cannot call it rapid) of messages to take place through the telephone.

TESTS OF A SPRAGUE NO. 6 STREET CAR MOTOR.

BY

Cary T. Hutchinson

The tests of which the results are given below were made recently on a pair of No. 6 double-reduction street car motors by Dr. Louis Duncan, Mr. Carichoff and the writer.

The methods used were the two described by me in The Electrical Engineer, of August 31. In brief these methods consist in running two machines, one as motor and the other as a dynamo, with the field strengths of the two the same, and at the same speed; this makes all losses in the two, except the $C^2 R$ loss in the armature, the same. The efficiency is deduced for a standard resistance; *i. e.*, the efficiency is deduced for certain resistances, irrespective of the actual state of the motor. This amounts to a determination of efficiency at a certain temperature.

The efficiency is calculated by the formula:

$$\varphi = \tfrac{1}{2}\left[1 + \frac{C_2}{C_1} - (C_1 + C_2)\,\frac{R_0 + r_0}{E}\right]$$

C_1 is the current in the motor.
C_2 is the current in the dynamo.
E is the P. D. at the motor.
R_0 is the standard field resistance.
r_0 is the standard armature resistance.
φ is the efficiency.

This motor, in service, is regulated by commutating the fields, as is well known; the switch positions are:

I. A + B + C.
II. B + C. (A short-circuited).
III. B + C. (A cut-out).
IV. (A in parallel with B) + C.
V. A in parallel with B. (C short-circuited).
VI. A in parallel with B. (C cut-out).
VII. A in parallel with B in parallel with C.

It will be seen at a glance that I, IV, and VII are the running positions; II and III have the same ampere-turns as IV, but higher resistance; V and VI have the same ampere-turns as VII, but higher resistance. It is little short of criminal to run on III or VI, yet this was common practice at one time.

Following are the data for these motors:

Rating: 15 B. H. P.

Armature: Drum; 56 divisions, each wound with 8 turns 14 B. W. G.; 56 bars in commutator.

Fields: Three coils on each leg; each coil has 11 layers, each of 31 turns 14 B. W. G.

The standard resistances to which all results are reduced are for I, 11.5 ohms; IV, 6.1 ohms; VII, 2.15 ohms. These include the armature resistance; this latter varies from .75 to .93 ohm; the field resistances at different temperatures vary 40 per cent. Ampere-turns for I, 2046 × current; IV, 1364 × current; VII, 682 × current.

Gearing ratio is 11.77.

$$\text{Armature flux} = 6.7 \times 10^6 \frac{\text{counter E. M. F.}}{\text{revolutions per minute}}.$$

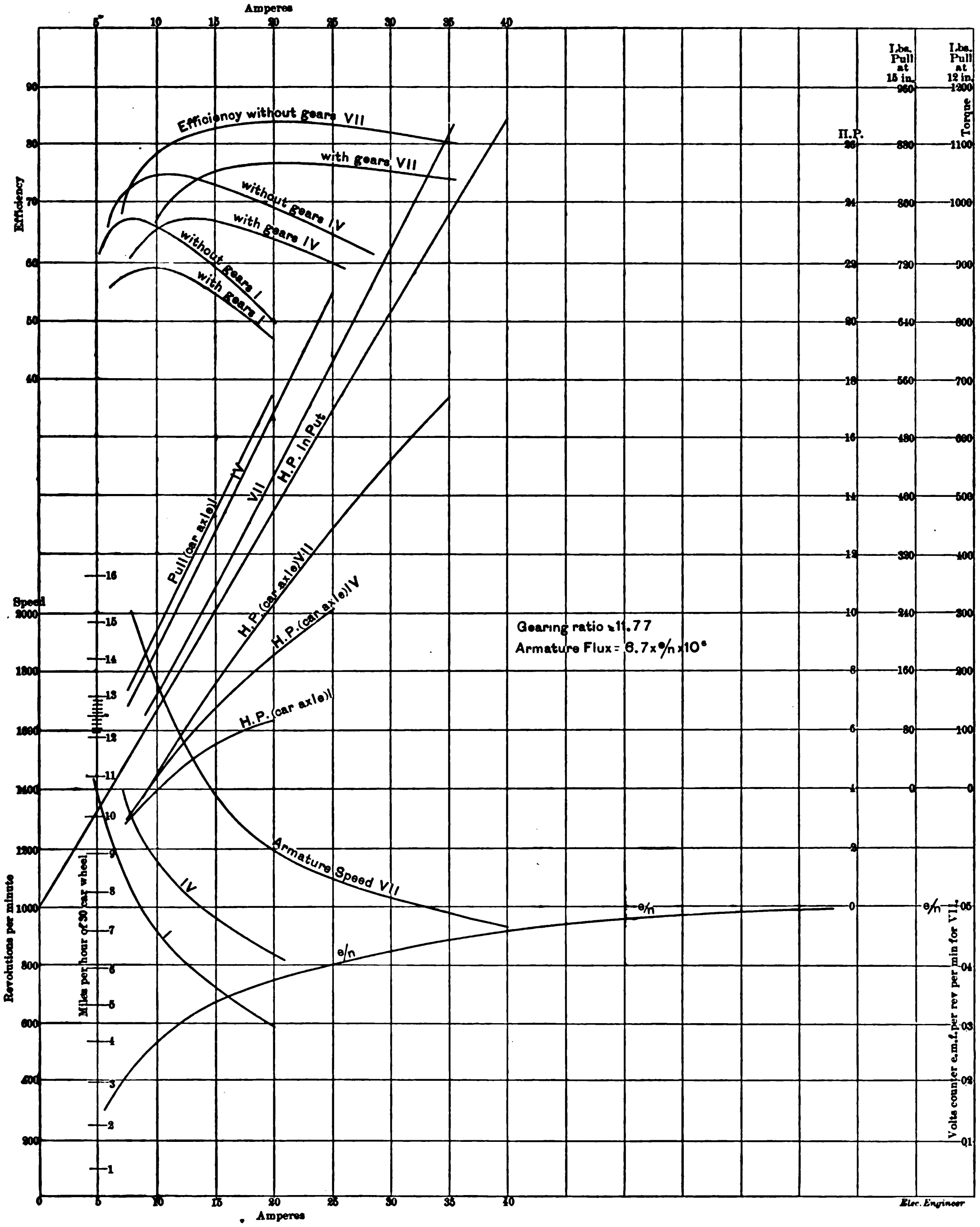
$$\text{Armature induction} = \frac{\text{armature flux}}{335}.$$

$$\text{Miles per hour, for 30-inch wheel} = \frac{\text{armature speed}}{132}.$$

The general dimensions are:

Bore of poles	10	inches
Diameter armature, over all	9	"
Length poles	10¼	"
Diameter of core	8¾	"
Gap	⅝	"

The curves in the accompanying diagram give the results. The six curves in the upper left hand corner are the efficiencies, with and without gears, for the I, IV and VII positions. The three lines below give the pull at the car axle for the three positions; below is the curve of input; still lower are three curves showing output for the three positions. Then come the speed curves, and at the bottom, extending across the sheet is the characteristic of the machine, plotted in terms of volts generated ÷ revolutions per minute, as ordinates, and current values as abscissæ. Current × 682 gives ampere-turns.



Tests of a Sprague No. 6 Street Car Motor.

THE FIRST ELECTRIC RAILWAY POWER STATION IN NEW YORK CITY.

TOWERING away above the tallest trees some distance from the Boston road near West Farms, may be seen the round top of a new brick chimney, over two hundred feet high and 16 feet in diameter at its base. This massive pillar of brick marks the location of the first and only electric railroad power station in New York City. At this station electricity is generated for supplying power to the Harlem Bridge and Fordham electric railroads and its branches, at present about twenty miles of double track and trolley wire, all operated by the Union Railway Co.

The power house is a brick building 200 feet long by 75 feet wide; the roof is supported by an iron truss frame. A 75-foot traveling crane rolls on an iron track which forms the top of the walls extending the whole length of the building. The crane has a lifting and carrying capacity of 30 tons. It was used in hoisting and placing the heavy parts of the engines and dynamos and is intended for general repair work in the future.

The station is equipped with four 500 h. p. Babcock & Wilcox water tube boilers, supplying steam to four large Cooper compound condensing Corliss engines of 400 h. p. each, with driving wheels 20 feet in diameter and 41-inch face, having a speed of 72 revolutions per minute. Belted direct to these engines are four 300,000-watt Thomson-Houston, multipolar generators. These machines are all insulated from the earth by being leveled up 1 inch from the firm concrete foundation and the space filled up with melted sulphur, which forms a solid bed around the base of the dynamo, insuring perfect insulation and a permanent anchorage.

It will require the power of but two generators to operate the road equipped at present, and a relay of two machines will be kept in readiness to start at a moment's notice should anything happen to either engine or dynamo in operation.

The station has been built of sufficient size to permit the railroad company to double the present power plant and not move or change any of the completed work. Several miles of the road operated by this company runs under the elevated structure of the Suburban Railroad Company on Third avenue, where no poles are needed as the trolley wire is supported from the iron structure of the elevated road.

A plank 1 inch thick and 10 inches wide with strips screwed to its edges—forming a wide inverted groove, is bolted to the angle iron of the elevated structure, and the trolley wire is fastened to the plank by a special insulator, every 12 or 15 feet about 3 inches below the grooved plank.

This acts as a guard to keep the trolley from striking the iron structure should it leave the wire, and also removes every possibility of the wire coming in contact with the iron above. The caution that has been exercised in making a perfectly insulated trolley wire reduces to a minimum the possibility of its ever falling to the street. About thirty cars are now running. These are all equipped with the Thomson-Houston single-reduction motors. The handsome cars were made by the St. Louis Car Co., of St. Louis, Mo.; the trucks are of the Peckham manufacture.

Mr. L. H. McIntire, formerly of the General Electric Co., is consulting engineer of electrical construction. His office is in the Union Railway Company's office, 2388 Third avenue, New York.

It may be added that the cars have been crowded with passengers from the outset, and that it is frequently very difficult to get any footing on them so thickly wedged together are the passengers. Work is being rapidly pushed on a number of the new lines in the district, and each will go into operation speedily.

Since the above was written, Mayor Grant has declined to approve the Ninth Avenue Trolley Line in this city.

MISCELLANEOUS.

ON THE LAW OF HYSTERESIS (PART II) AND OTHER PHENOMENA OF THE MAGNETIC CIRCUIT.[1]

BY CHARLES P. STEINMETZ.

IN a former paper "On the Law of Hysteresis"[2] the author has shown that the energy converted into heat during a complete cycle of magnetization can be expressed by the empirical formula,

$$H = \eta B^{1 \cdot 6},$$

where $\pm B$ is the maximum magnetic induction reached during the cycle process, and η a "coefficient of hysteresis." He has given the numerical values of this coefficient, η, for different materials, varying for: Wrought iron, between .002 and 0045; cast iron, .016; annealed steel, .008 to .012; hardened steel, .025 to .082 in manganese steel; magnetite, .020.

He has also shown that this "coefficient of hysteresis," η, is apparently independent of the speed of reversal within practical limits, being the same for slow reversals as for rapid alternations up to somewhat over 200 complete periods per second. The tests published covered the whole range, from very low magnetization, $B = \pm 85$ lines of magnetic force per cm.^{2} up to saturations as high as $B = \pm 19{,}000$ lines of magnetic force per cm.^{2} giving fair agreement with the law of the 1.6th power.

Under conditions where eddy or Foucault currents were induced in the iron, the loss of energy followed the more general formula,

$$H = \eta B^{1 \cdot 6} + \varepsilon N B^2,$$

where N is the frequency, H the whole loss per cycle and cm.^{3} in ergs or absolute units, and $H_1 = \eta B^{1 \cdot 6}$ represents the loss by molecular hysteresis; $H_2 = \varepsilon N B^2$ represents the loss by eddy currents.

To determine the loss of energy in a magnetic cycle between two limits B_1 and B_2 the author made a number of tests: 1. By the electro-dynamometer method, by employing *pulsating* currents for the excitation of the magnetizing helices; that is, currents which were derived by the superposition of an alternating and a continuous E. M. F. 2. By means of the Eickemeyer differential magnetometer, described in the former paper.

The electro-dynamometer tests were carried out after the manner illustrated in Fig. 1. By this method the voltmeter directly measures the E. M. F. induced by the fluctuation of the magnetism, that is, measures these fluctuations, while the wattmeter measures the time integral of the product of instantaneous values of main current into variation of magnetism, that is, the energy given off to the iron.

Fig. 2 gives the curve of hysteresis, with the values observed by means of alternating currents marked by crosses +, the values observed by pulsating currents marked by circles. The average value of magnetization, $\frac{B_1 + B_2}{2}$, is written in the figure in kilolines. The dotted curve is the magnetic characteristic.

These tests prove that *the energy dissipated by hysteresis depends only upon the difference of the limiting values of magnetic induction, between which the magnetic cycle is performed, but not upon their absolute values, so that the energy dissipated by hysteresis is the same as long as the amplitude of the magnetic cycle is the same, no matter whether the cycle is performed for instance between values of the magnetization,* $B_1 = +4000$ and $B_2 = -4000$; or $B_1 = +6000$ and $B_2 = -2000$; or $B_1 = +8000$ and $B_2 = 0$; or $B_1 = +14000$ and $B_2 = +6000$.

In either case the hysteretic loss is the same, since the magnetic variation is the same, $B_1 - B_2 = 8000$. *Hence the general form of this empirical law of hysteresis is*

$$H = \eta \left(\frac{B_1 - B_2}{2} \right)^{1 \cdot 6},$$

where B_1 and B_2 are the values between which the magnetism varies, η a constant of the material, in our case = .0035.

Including the energy dissipated by eddy-currents, we derive

$$H - \eta \left(\frac{B_1 + B_2}{2} \right)^{1 \cdot 6} + \varepsilon N \left(\frac{B_1 - B_2}{2} \right)^2,$$

where N is the frequency, ε a coefficient of eddy-currents.

The magnetometer tests were made by means of the Eickemeyer differential magnetometer. In determining the magnetic characteristic, before each test the magnetizing current, and therefore the magnetism, was reversed repeatedly to destroy the remanent magnetism left from former readings, and always *first readings with lower, than with higher magnetization, were taken to make sure that the remanent magnetism of the former test*

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[1] Abstract of a paper read before the American Institute of Electrical Engineers, Sept. 27, 1892.

[2] THE ELECTRICAL ENGINEER, Jan. 27, 1892, *et. seq.*

would be destroyed by the reversal of magnetism in the following test. The hysteretic curves were taken by varying the magnetizing current cycle and taking readings at every step.

The conclusion derived from these tests is the same as that derived from the electro-dynamometer tests, namely, that the loss of energy by hysteresis can be expressed by the equation

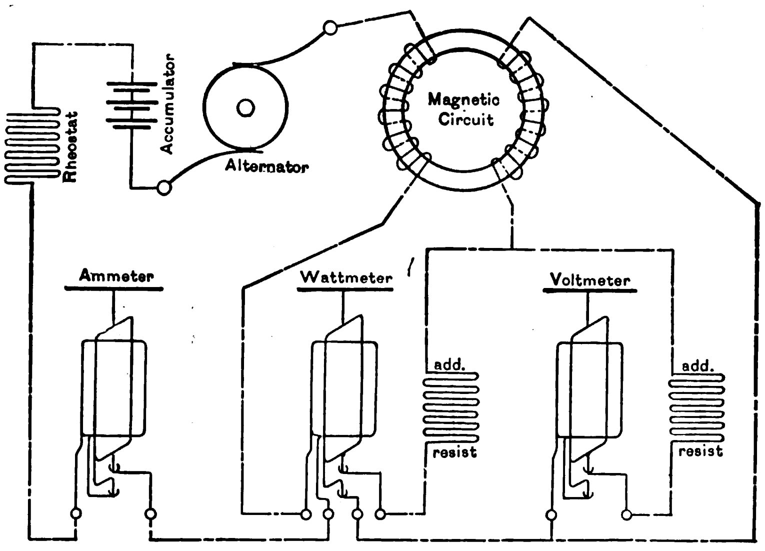


FIG. 1.

$$H = \eta \left(\frac{L_1 - L_2}{2}\right)^{1.6}.$$

Hence the magnetic properties of this cast iron can be expressed by means of the equations

$$\rho = \alpha + \sigma F, \quad H = \eta \left(\frac{L_1 - L_2}{2}\right)^{1.6},$$

and by three constants, α, the "*coefficient of magnetic hardness;*" σ, the "*coefficient of magnetic saturation;*" η, the "*coefficient of magnetic hysteresis.*"

Only for values of $F \leqq 20$ the value of ρ, the metallic reluctivity, if determined by *reversals* of magnetism, is larger and may necessitate the introduction of a term, $c\, e^{-\delta F}$, or of similar shape.

The term α Mr. Steinmetz calls the "coefficient of magnetic hardness," since the value of α determines what is called "magnetically hard." He shows, also, that α is smallest in soft Norway iron, increases by hardening and reaches very large values in hardened steel. The term σ he calls the "coefficient of magnetic saturation," because $L_\infty = \frac{1}{\sigma}$ is the value of absolute saturation of the metallic induction, that is, the value which the metallic induction reaches for infinitely large M. M. F's., that is, for values larger than $F = 1000$ to $20{,}000$ (according to the value of magnetic harness α).

A large number of tests were made upon Norway iron, wrought iron, mitis iron, annealed cast steel, ferrotype iron. Norway iron was shown to be the softest metal magnetically, while mitis metal behaves almost exactly like wrought iron. Tests of mitis metal showed that for all practical purposes it may be considered magnetically as identical with ordinary good wrought iron. Cast steel was shown to be far superior to ordinary good wrought iron and almost approaches Norway iron. Tests were also made on amalgams of iron and nickel, and porous iron obtained by evaporating the mercury from the amalgam; also upon magnetite and cobalt. The author also discusses some of the tests of Ewing, and refers to the article by Kennelly published in THE ELECTRICAL ENGINEER of April 6, 1892, in which that investigator proves the existence of the law of the 1.6 power to hold good for the hysteresis of nickel.

The following conclusions are arrived at as the results of these tests:

1. The dissipation of energy into heat by molecular hysteresis, during a complete cycle of magnetization performed between the limiting values of magnetic induction L_1 and L_2, is expressed by the formula

$$H = \eta \left(\frac{L_1 - L_2}{2}\right)^{1.6},$$

where L_1 and L_2 very likely have to represent the metallic magnetic induction,

$$L = B - H = 4 \pi I,$$

while, when eddy—or Foucault—currents are induced by the cyclic variation of magnetization, the dissipation of energy is given by,

$$H = \eta \left(\frac{L_1 - L_2}{2}\right)^{1.6} + \varepsilon N \left(\frac{B_1 - B_2}{2}\right)^2$$

where the first term is the loss by molecular hysteresis, the second term the loss by eddy-currents, and N denotes the frequency.

2. Beyond a certain minimum value of M. M. F. F_m, the metallic magnetic reluctivity, ρ (and consequently the inverse value of susceptibility, κ, which is, $\frac{1}{\kappa} = \frac{16 \pi^2}{10} \rho$) follows the linear law,

$$\rho = \alpha + \sigma F$$

Below this minimum value of M. M. F. F_m first the curve of alternating, then that of rising magnetism drop below, while the curve of decreasing magnetism rises above the curve derived from the linear law, $\rho = \alpha + \sigma F$.

3. Beyond a certain minimum value F_m, that is for medium and high M. M F.'s. all the main features of the magnetic properties of materials can be expressed by three constants, α, σ, η,

α, the coefficient of Magnetic Hardness,
σ, the coefficient of Magnetic Saturation,
η, the coefficient of Magnetic Hysteresis.

Instead of α, σ and η the three constants may be used,

$L_\infty = \frac{1}{\sigma}$ the value of absolute magnetic saturation.

$F_0 = \frac{\alpha}{\sigma}$ that M. M. F., where half-saturation $\frac{L_\infty}{2}$ would be reached if the linear law of reluctivity holds already for F_0.

$H_\infty = \eta\, L_\infty{}^{1.6}$ the maximum value of hysteretic dissipation of energy, for absolute saturation.

Then we have the equations:

RELUCTIVITY,

$$\rho = \alpha + \sigma F = \frac{F_0 + F}{L_\infty}$$

HYSTERESIS,

$$H = \eta \left(\frac{L_1 - L_2}{2}\right)^{1.6} = H_\infty \left(\frac{L_1 - L_2}{2 L_\infty}\right)^{1.6}$$

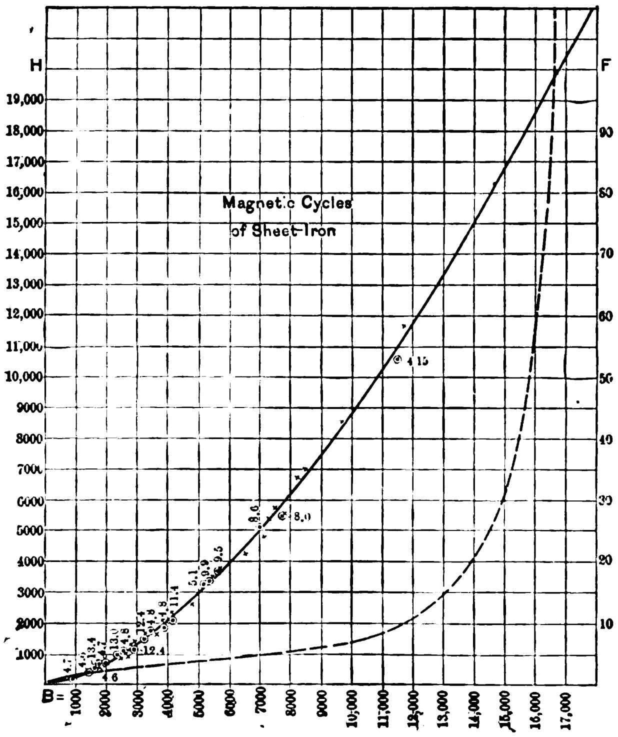


FIG. 2.

In the latter case the exponent 1.6 only covers an absolute number, while the coefficient of hysteresis H_∞ is of the dimension "work" or "energy," = (cm.^{2} g sec^{-2}).

4. These formulas hold for all kinds of wrought and cast iron and steel, for nickel, and magnetite, and most likely for amalgam of iron, hence apparently for all magnetizable materials.

For air simply σ and $\eta = 0$, $\alpha = 800$.

Fig. 3 shows the magnetic characteristics of the most interesting of the materials tested.

The author gives the following tables regarding the magnetic constants and properties of average materials.

MAGNETIC CONSTANTS OF AVERAGE MATERIALS.

MATERIAL.	Coefficient of			Absolute saturation	$F >$ =
	Mag. hardness a	Mag. saturation σ	Mag. hysteresis η	L_∞	
Average wrought and sheet iron, soft annealed cast steel and mitis metal......	.3	.055	.008	18.2	7
Average cast iron, cast steel of low permeability...	2.4	.095	.018	10.5	18
Average soft steel, hard cast steel of high permeability	1.33	.06	.02	16.7	40
Average glass-hard steel.................	8	.1	.07	10.0	90

Tests were also made on coiled wire, laminated iron and iron filings for all of which the law was found to hold true.

The looped curve of hysteresis measures the energy expended by the M. M. F. during a complete cycle. It has been assumed then, that the area of this loop represents the energy consumed by molecular friction in the iron. This, the author asserts to be a fallacy. The area of this looped curve is not the energy dissipated by molecular friction in the iron. Warburg and Ewing have shown—the former by supposing the cycle of M. M. F. performed by changes in the position of steel magnets, and determining the energy expended in performing these changes in position; Ewing by supposing the magnetic cycle produced by a cyclic variation of the exciting current in a magnetizing helix and calculating the energy consumed by the E. M. F.'s induced in the magnetizing helix by the cyclic variation of magnetic induction—that the energy expended by the M. M. F. during a complete cycle is equal to the area of this looped curve.

Hence, it has been concluded that the area of this loop represents the energy expended by molecular friction in the iron. Here is the mistake in the conclusion. For :

MAGNETIC PROPERTIES OF AVERAGE MATERIALS.

	Average wrought and sheet iron.		Average cast iron.		Average soft steel.		Average glass-hard steel.	
F	L	H	L	H	L	H	L	H
1	.4	.1						
2	1.7	.4			.2			
3	3.8	1.6						
4	5.6	3.0			.6			
5	7.5	4.8	.7	1	.8	1	.1	
6	9.9	6.4			1.0			
7	10.1	7.6						
8	10.8	8.5			1.7			
9	11.4	9.3						
10	11.8	9.0	1.9	2	2.5	5	.3	1
12	12.5	10.8			3.5			
15	13.4	12.1	3.7	7	5.0	17	.5	2
20	14.3	13.5	4.6	10	7.0	29	.7	4
25	14.9		5.2	12	8.3	38	.9	5
30	15.4	15.1	5.7	14	9.3	44	1.2	7
35	15.7		6.1	15	10.1	50	1.5	9
40	16.0	16.0	6.5	17	10.7	55	1.9	13
45	16 2		6.8	18	11.2	59	2.3	17
50	16.4	17.0	7.0	19	11.5	63	2.7	22
60	16.7		7.4	20	12.1	69	3.5	33
70	16.9		7.7	22	12.6	73	4.3	46
80	17.0		8.0	23	13.0	77	4.9	55
90	17.1		8.2	24	13.4	80	5 2	63
100	17.3	18.0	8.4	25	13.6	83	5.5	69
120	17.4		8.7	26	14.1	87	6.0	78
.40	17.5		8.9	27	14.4	90	6.4	85
160	17.6		9.1	28	14.6	93	6.7	91
180	17.6		9.2	29	14.8	95	6.9	97
200	17.7	19.0	9.3	29	15.0	96	7.1	102
Absolute Saturat.	18.2	19.6	10.5	36	16.7	114	10.0	176

"The area of the looped curve of hysteresis represents the energy dissipated by molecular magnetic friction then, and only then, when during the magnetic cycle neither energy is exerted upon the magnetic circuit by another source of energy, nor work done by or in the magnetic circuit."

Instances of the first case have been observed—and frequently misinterpreted.

That the law of the 1.6th power holds, proves, that this law does

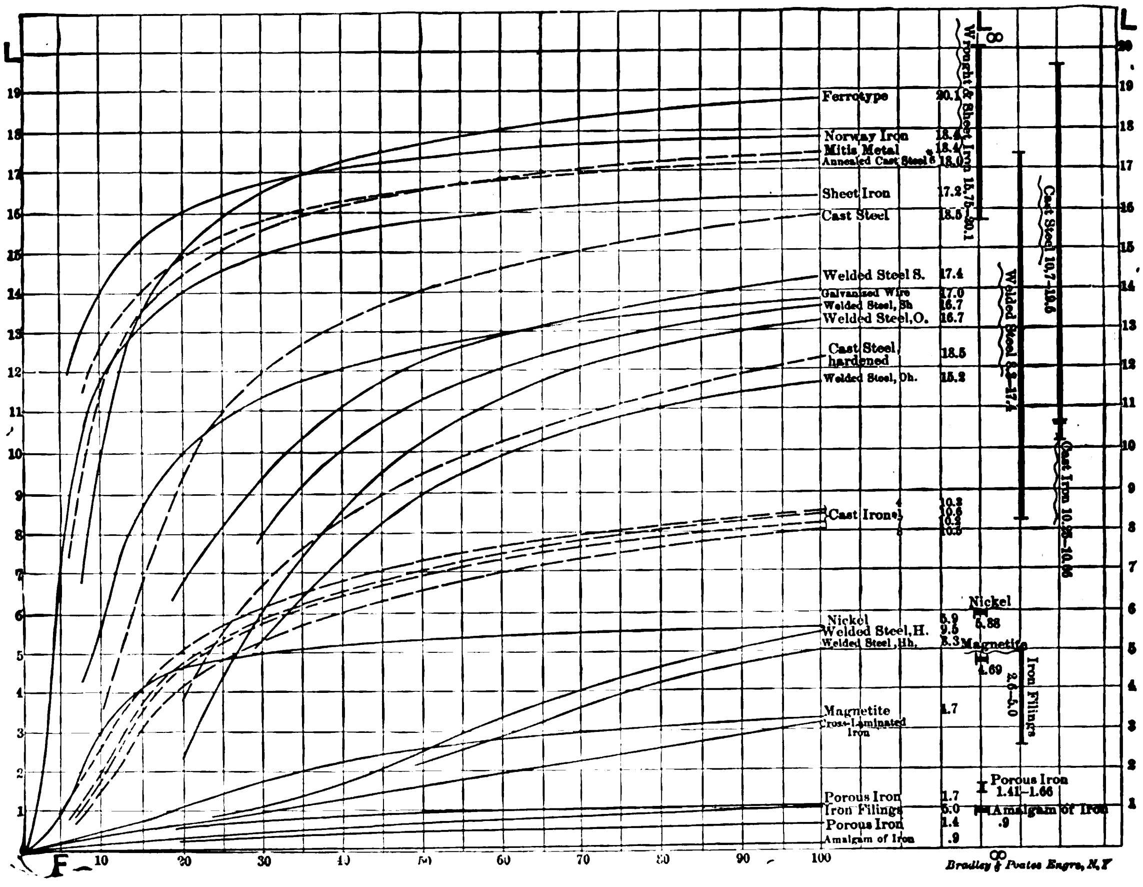


FIG. 3.

not depend upon a particular constitution of the material, but is of more general meaning. It is highly probable, that the initial inward bend of the magnetic characteristic, and the deviation of the metallic reluctivity from the linear law caused thereby, is merely due to the expenditure of energy by M. M. F. for molecular friction, and that consequently, if the energy of molecular friction is derived from another source, for instance mechanical vibration, the magnetic reluctivity follows the linear law from the beginning, as observed by Ewing, and the inward bend of the magnetic characteristic disappears.

The author finally discusses the theory of molecular magnets, pointing out that the kinetic theory of gases, thermo-dynamics, etc., make the theory of Ewing untenable, as all these theories lead to the conclusion that the dimensions of molecules are infinitely small compared with their distances apart; whereas Ewing assumes the distance of the centres of molecular magnets to be not much greater than their length.

The final conclusions of the author are as follows:

As a rough approximation, the magnetic induction and the molecular friction depend upon the M. M. F. by the law of probability of molecular distances. The point of maximum increase of induction is not the same as the point of maximum increase of molecular friction, since different factors enter into the function of probability.

The law of hysteresis, of the 1.6th power, is the interdependence of two functions depending upon the same law of probability, hence can be of simpler form than either function.

THE SECOND ANNUAL MEETING OF THE AMERICAN ELECTRO-THERAPEUTICAL ASSOCIATION.

THE AMERICAN ELECTRO-THERAPEUTICAL ASSOCIATION held its second annual meeting at the New York Academy of Medicine, 17 East Forty-Third street, on the 4th to the 6th inst., inclusive. The exercises consisted of executive sessions, the reading and discussion of papers, and set discussion upon predetermined subjects, after the custom of the German medical congresses. The last feature was an entire innovation and met with enthusiastic praise. In connection with the convention an exhibit of electro-medical apparatus was made by leading manufacturers of the country. The officers for the past year have been: President, Dr. W. J. Morton; vice-presidents, Dr. Augustin H. Goelet, Dr. Wm. F. Hutchinson; secretary, Dr. Horatio R. Bigelow; treasurer, Dr. R. J. Nunn; executive council, Dr. G. Betton Massey, Dr. Robert Newman, Dr. A. D. Rockwell, Dr. W. H. Walling, Dr. H. E. Hayd.

FIRST DAY'S PROCEEDINGS.

On Tuesday, Oct. 4, the meeting was called to order at 10 a. m., when an executive session was held and new members elected. The president, DR. WILLIAM JAMES MORTON, then delivered the opening address.

ADDRESS OF THE PRESIDENT.

The president, after a few introductory remarks, called attention to the fact that electro-therapy has been sadly overlooked and ignored by the medical profession, and left too long to the designing, the ignorant and the incompetent, with the natural result that a certain contempt is felt by the public for the methods of these men, generally not physicians, and hence for the science which they dishonor. This discredit of so important a branch of the medical profession, he said, will disappear with a higher education, and a consequent purging of electro-therapy from mystery by those whose labors are undertaken in a purely scientific spirit. And now, said the speaker, a glance at where we stand to-day. As a result of the changes which have worked themselves out in industrial and commercial relations the electrical engineers have arisen, self-taught, and acquiring science as they need it. In advance of them the new science has sprung into being. Electricity has emerged from its thraldom, cast aside the restraints of the class-room and become a part of practical life. Now it has invaded the realm of medicine, and the physician is turning to the physics of electricity and acquiring the lore of the electrical engineer. We welcome the electrical expert. To-day an exact science, electricity, knocks at the door of medicine, an inexact science, and demands a hearing. In the onward march of measures for the relief of crippled humanity I see electro-therapeutics struggling to the vanguard. There are positive pillars of fact upon which that faith is based.

Instances were then cited of the effect of electricity in the excitation of the living protoplasm, in electrolysis, in cataphoresis, and the familiar vaso-motor effects were mentioned. It is not improbable, said the speaker, in conclusion, that a final contest in the cure of diseases is between the physical phenomena we term electric and the chemico-biological processes of metabolism exhibited by the animal cell; between electricity on the one hand, which in the human body by electrolytic conduction becomes a chemical process, and, on the other hand, the chemical processes which constitute life in the organism—chemistry against chemistry.

Reports were then read from the Committees on Standard Cells, Standard Meters, and Arrangements, after which the first paper, on The Use and Abuse of Electricity in Medicine, was read by DR. A. D. ROCKWELL, of New York. Dr. Rockwell strongly advocated the use of the electric current in certain forms of treatment, by physicians skilled in its application, and severely condemned the injudicious and unskillful trifling with an agent so powerful for good or ill. He exhibited a patient who had been thrown down and dragged by a railway train, sustaining injuries which caused partial paralysis and totally unfitted him for any manual work, and who had so far recovered, under electric treatment, that he has resumed his old employment of baggage handler.

The Rôle and Range of Electricity in Therapeutics, by DR. T. W. POOL of Lindsay, Ontario, was read by title, the author being absent.

A paper by DR. G. APOSTOLI, entitled New Contributions of the Electrical Treatment (both Faradic and Galvanic) to the Diagnosis in Gynæcology, was read by Dr. Hutchinson. Dr. Apostoli has probably done more to advance practical electro-therapeutics than any one else, and the paper, consisting principally of reports of actual cases treated by him was listened to with great interest. The fact was brought out that painful and mutilating operations can frequently be avoided by the use of the current in diagnosis. A long discussion followed the reading of the paper, during which the various forms and materials of electrodes for medical use were considered.

The afternoon session commenced with the reading of a paper on A New Treatment of Prostatic Hypertrophy, by DR. G. B. MASSEY, of Philadelphia. A discussion upon "Electric Cataphoresis and its Practical Application as a Therapeutic Measure" was opened by DR. FREDERIC PETERSON, of this city. Dr. Peterson stated that he had made experiments and counter-experiments upon himself with substances applied to the skin alone, with electricity alone; with drugs upon the anode and upon the cathode, and all details had been carefully recorded, the possibility of error due to personal equation had then been eliminated by expermenting upon patients. The results have since been published in the *N. Y. Medical Journal* of April 27, 1889, and Nov. 15, 1890; the *N. Y. Medical Record*, Jan. 31, 1891; and the *Phil. Times and Register*, March 21, 1891. The speaker said that his discussion brought together the results of the use of cataphoresis in various lines of practice. Great interest centres also in the nature of the physical process by which substances are thus diffused, and accordingly Mr. A. E. Kennelly and Prof. E. J. Houston were called upon to read papers upon the subject from the standpoint of the electrician and the physicist.

MR. A. E. KENNELLY being absent, his paper entitled "On the Physics of Cataphoresis," was read by Dr. Peterson. The author stated that the cataphoric action of electric currents, sometimes called electrical endosmose, was discovered by Reuss in 1807. Wiedemann, in 1852, described the laws controlling the action, which were corroborated later by Freund and others. When two liquids are brought into communication through a narrow channel and an electric current is passed, a flow accompanies the current in the same direction from positive to negative. In rare instances this flow is in the opposite direction. The total quantity of liquid depends on the quantity of current. Wiedemann found the rate of transfusion approximately proportional to the resistivity of the aqueous solution of any given salt.

The explanation of cataphoresis is based upon the same electrostatic force and motion by which Thales first placed electricity upon record, and by which pith balls, etc., are made vehicles of energy when electrified. It seems to be a general law that the contact of any two dissimilar substances gives rise to an electrification and difference of potential between them. In the case of a glass tube containing a homogeneous liquid and subjected to a steady current, the liquid particles next the glass receive a charge and are moved along the tube. This moving force accelerates the particles until the friction due to their velocity balances the moving force. This will determine the rate of electric transfusion through the tube for the particular strength of current employed. If a porous diaphragm be regarded as a framework supporting a number of tubes the principle will be the same.

When it is desired to produce the greatest transfusion the solution should be as weak as possible to increase its resistivity, since pure water is nearly a non-conductor. Wiedemann showed that, roughly, the transfer of liquid was inversely proportional to the percentage of solid contacts. This, however, is not strictly true and the rule is not clearly defined. On one hand the conductivity of an aqueous solution of salts generally increases more slowly than the percentage of solid contents, and, on the other hand, the effect of the increasing strength of the solutions upon their contact electrification is not yet clearly determined. A large and inviting field seems to be open here for experimental research, for, although the theory of cataphoresis appears to satisfactorily explain the facts, the measurements that have been yet made with standard diaphragms and solutions seem all too few.

PROF. E. J. HOUSTON, of Philadelphia, next took the floor, and presented a paper upon the same subject. The author commenced by defining cataphoresis, and added that cataphoric action. Porret's phenomenon, electric endosmose, electro-capillary phenomena, electro-vection, and electro-filtration may be considered synonymous terms. He quoted Becquerel as saying that exosmose is due partly to diffusion and partly to filtration.

After citing a number of phenomena due to osmotic action, the action of the electric current flowing through the liquid and the porous wall or septum was considered. In this case a movement of the liquid takes place in the direction of the current, that is, the level of the liquid rises on the side of the negative electrode and falls on the positive side. Regarding the skin or other membranes of the body as septa, if electrodes moist with medicinal substances be applied to different parts of the body, and a current passed, a flow of the solutions takes place by means of which they are carried into the tissues of the body. This action, the author considered from a physicist's standpoint, and mentioned the work of Reuss, the first observer, Porret, Graham, Napier, Dutrochet, and De la Rive. After quoting from the works of these experimenters he said, in effect, The problem of extending the field of electro-physiology belongs to the electro-therapeutists. To me, as a physicist, it seems that whenever a constant electric current is passed through the body a cataphoric action must go on. The result must be to engorge certain parts and deplete other parts, and it is possible that the value of the treatment may arise mainly from such action in many cases, by the transportation of morbid matter from one place to another. This probably explains why so often only one electrode acts therapeutically, while the other is indifferent. Again, the resistance of the body cannot remain uniform, since cataphoric action presumably accompanies the passage of the current, and since the cataphoric action increases with the strength of the current, the resistance of the body will vary with the strength of the current employed to measure such resistance. This does not refer to change resulting from polarization.

In conclusion, the author called attention to the two varieties of cataphoric action; normal, by means of which a disturbance of the distribution of the constituents of the body is effected by the passage of an electric current, and abnormal, by whose means fluid substances are introduced into the body from without by the passage of a current.

Dr. Morton then called attention to the fact that electrolysis and cataphoresis act together in many of the phenomena frequently attributed solely to cataphoresis. He left out of the discussion the application of cataphoresis to surgery, etc., and devoted himself to cataphoric medication and demedication, electric baths, etc.

The discussion upon the uses of cataphoresis in general surgery, in the absence of DR. W. H. WALLING, of Philadelphia, was read by title, and after a short paper by DR. A. H. GOELET, of this city, upon its uses in gynæcology, the discussion was closed by Dr. Peterson who read a paper on cataphoresis in nervous diseases.

EVENING SESSION.

In the evening DR. R. J. NUNN, of Savannah, Ga., read a paper on "Stable Electrodes; Old Materials Newly Arranged." He preferred a pad of woolen or cotton cloth moistened with water as an electrode. Dr. Massey said that white clay had the advantage of being alkaline. Other materials were also advocated. Prof. Houston suggested the mixing of graphite with the clay to increase the conductivity. The discussion was closed by some general remarks by Dr. Nunn.

A paper on "The Value of Voltaic Alternatives in Optic Nerve Atrophy," by DR. C. E. RIGGS, of St. Paul, Minn., was read by title. "The Present Status of Electrolysis in the Treatment of Strictures," by DR. ROBERT NEWMAN, of this city, was postponed, as Dr. Newman was confined to his house by illness, and the evening session closed with the reading of a paper on "Some Phases of Neurasthenia and their Treatment," by DR. W. F. ROBINSON, of Albany.

After the evening session the members of the Association headed by President Morton, visited the Electric Club and were entertained, "lunch and punch" having been provided. The reunion was very enjoyable, and was kept up until the small hours of the morning.

WEDNESDAY—MORNING SESSION.

A paper on "The Need of Greater Simplicity and Uniformity in Electro-Therapeutic Apparatus" was read by DR. W. J. HERDMAN, of Ann Arbor, Mich. He called attention to the necessity of adopting standards for every piece of apparatus used in electro-therapeutical work, and discussed the various forms of current for medical uses. Especial stress was laid upon electrodes. Dr. Hutchinson said that the present electro-medical apparatus was altogether too complicated, and urged simpler apparatus.

A paper postponed from Tuesday evening entitled "A Contribution to the Electrical Treatment of Cystic Goitre and Hydrocele," and also a "Note on Psoriasis" was read by DR. C. R. DICKSON, of Toronto, Canada. A long discussion followed.

A paper entitled "Medical Electricity from an Electrician's Standpoint" was then read by MR. J. J. CARTY, electrician of the Metropolitan Telephone Company. Mr. Carty first stated that there should be a thorough understanding of terms between electricians and physicians, which at present does not exist. "Faradism," he said, is referred to in medicine in a narrow sense. It applies to the current generated in induction coils. "Galvanism" in medicine refers to the current obtained from a battery, and "Franklinism," to effects produced by discharges from Leyden jars and static machines. The differences between these three "isms" is one of degree only. The term "resistance" has lost its original significance, as it differs according to the current used, and various other conditions.

It can be safely asserted that the resistance of an inorganic body, using "resistance" in its broadest sense, is different for every degree and form of current. Taking this view of the case, a more intelligent selection of currents for the human system can be made. Some parts of the body may possess high self-induction, while others obey the ordinary laws of conductivity, and still others may act as condensers. If the periodicity of the current is of so much importance ordinarily, it would seem that it must be of some account in the highly organized human system, and yet we hear little of the periodicity of Faradic currents or of their characteristic curves. After calling attention to the work of Clerk Maxwell in support of the electromagnetic theory of light and the recent experiments of Hertz, the author referred to Tesla, whose labors have opened such an enormous field for research and spoke of the peculiar effect of the Tesla electric bombardment. In closing, he quoted Siemens as saying, after the experiments of Hertz: "Electricity has annexed the whole domain of optics," and added the hope that the labors of the Association may be so crowned with success that some day electricity will annex the whole domain of medicine.

During the discussion on this paper Mr. Carty illustrated his remarks upon the blackboard, and Dr. Kellogg made some sketches showing work done by him in determining Faradic curves.

DR. W. F. HUTCHINSON, of Providence, R. I., next read a paper on "Anæsthetical Electricity," in which he called attention to the value of galvanism to allay pain, and the benefit of using a current in connection with medical treatment.

AFTERNOON SESSION.

In the afternoon the first paper read was one on "Some Physiological Experiments with Magnets at the Edison Laboratory," by DR. FREDERICK PETERSON and MR. A. E. KENNELLY.

After a few words in regard to the effect of magnetism upon certain forms of hysteria, etc., and quoting Profs. Benedikt, Roberts, Bartholow and Dr. Vansant on the subject, the authors described experiments made by them with magnets of great power at the Edison laboratory at Orange. The pole-faces of the magnet, which two men were required to lift, were 1.2 cm. apart, and between these poles objects were placed for observation. The intensity of the field was about 5,000 C. G. S. lines per square cm. A drop of water on a glass slide in this field was visibly distorted. Experiments were made on blood, which was found to be unaffected in any way. Experiments upon frogs failed to give any result. Then the effect of a continuous current was noted, and circulation was found to cease. Benedikt's statement that magnetism will produce paralysis was then tested. A set of idle field magnets converging into a cylinder two feet in diameter and seven inches deep was employed. In this cylinder a dog was placed for five hours without the slightest visible effect. Experiments were next tried upon the brain. The armature and one journal were removed from a dynamo converting about 70 h. p. at full load, and in the space between the pole pieces the subject placed his head. The intensity of the magnetic field produced was about 2,500 C. G. S. lines per square cm. A switch was arranged to open and close the exciting circuit. Sphygmographic tracings, taken continously, showed no change in regularity. The respirations were not changed in the least, and there were no sensations that could be attributed to magnetic influence. Experiments in connection with reversed magnetism also failed to show any effect upon the subject. From these experiments, the authors conclude that the human organism is unaffected by the most powerful magnets known to modern science; that neither direct nor reversed magnetism exerts any perceptible influence upon the iron in the blood, upon the circulation, upon ciliary or protoplasmic movement, upon sensory or motor nerves, or upon the brain.

A discussion was then held upon "The Relative Fœticidal Value of the Galvanic and Faradic Currents in Ectopic Gestation," on which the following points were emphasized:

How does electricity destroy the life of the fœtus? Which current should theoretically be more certain in its results? And what is the individual experience? Can electricity be depended upon to accomplish the desired end, and why? Should the galvanic current be used interupted or constant? What is the best method of applying the agent? What are its dangers? And how are they to be avoided? Who should apply it? Can it be safely intrusted to the general practitioner?

The discussion was opened by Dr. A. D. ROCKWELL, and continued by DR. WM. T. LUSK, DR. ALEX. J. C. SKENE, DR. FRANKlin H. Martin, Dr. Augustin H. Goelet, Dr. A. Lapthorn Smith, Dr. A. Brothers, Dr. Malcolm McLean, Dr. E. H. L. McGinnis, and Dr. A. H. Buckmaster.

After this subject had been exhausted, papers entitled "The Treatment of Salpingitis by Depletion and Drainage Secured by Electricity," by Dr. Augustin H. Goelet, of N. Y.; and "The Negative Pole of the Galvanic Current an Aid to Uterine Development, with Cases," by Dr. Charles G. Canaday, of Roanoke, Va., were read.

"Some Successes and Failures with Electricity in Gynæcology," by Dr. A. Lapthorn Smith, of Montreal, Canada, was then read by title, Dr. Smith being absent.

EVENING SESSION.

At the executive session, which opened the evening's proceedings, the following officers were elected for the coming year: President, Dr. A. H. Goelet, of New York; first vice-president, Dr. W. F. Hutchinson, of Providence, R. I.; second vice-president, Dr. W. J. Herdman, of Ann Arbor, Mich.; secretary, Dr. Margaret A. Cleaves, of New York; treasurer, Dr. R. J. Nunn, of Savannah, Ga. After the transaction of business a delightful reception was tendered the Association and guests by the resident members, where, during supper, many toasts were drunk to the continued success of the society, and to the individual retiring and incoming officers. During the evening a lecture on "The Phonograph and Microphonograph" with illustrations was given by Dr. J. Mount Bleyer of this city. The principles on which the instruments are worked was discussed, and the history of their invention alluded to. Reference was made to the use of the microphone for medical purposes to discover minute sounds inaudible to the unaided ear, such as the heart beats of a patient afflicted with catalepsy, the circulation of the blood in the arteries, etc. The treatment of deafness by means of the phonograph was also described, as well as the making of phonographic records of the voice in throat diseases for purposes of comparison.

THURSDAY—MORNING SESSION.

The proceedings on Thursday morning opened at 10 o'clock with the reading of a memorial of the late Dr. Gilman Kimball, by Dr. Ephriam Cutter, of New York. A paper on "Recent Experiences on the Treatment of Myomas" by Dr. G. Betton Massey of Philadelphia was then read and discussed.

The paper on "The Present Status of Electrolysis in the Treatment of Strictures," by Dr. Robert Newman, of this city, which was read by title during the first day's proceedings owing to the illnes of the author, was then read by Dr. Nunn, and its discussion postponed until the evening session.

On Thursday afternoon the members of the Association, at the invitation of Mr. Edison, visited the laboratory at West Orange, where they were received by Mr. A. E. Kennelly and his assistants, and spent two highly interesting hours in strolling about the extensive buildings and inspecting the various forms of apparatus. Dr. Belyer here gave a practicable demonstration of the phonograph and covered several cylinders with records of the voices of the visiting physicians.

EVENING SESSION.

The evening session commenced with a discussion upon Dr. Newman's paper on the treatment of strictures, read by Dr. Nunn at the morning session.

Dr. J. H. Kellogg, of Battle Creek, Mich., read a paper on "The Physiological Effects of Magneto-Electricity of Regular Variations" or sinusoidal current. The author began by referring to M D'Arsonval's studies upon the physiological effects of the alternating magneto-electric current, and quoted his statment that "The intensity of the motor, or sensory, reaction is proportionate to the variation of the potential at the point excited." The author some years ago experimented with a small magneto-electrical apparatus, or telegraph generator, and found that this machine produced powerful but painless muscular contractions. He then made an apparatus for graphically representing currents, from which many tracings from the machine referred to and also various forms of Faradic machines were made. A number of these curves were shown. That due to the Faradic current was uneven with respect to the zero line, while that of the magneto-elebtric machine corresponded exactly with those obtained by D'Arsonval. The comparative painlessness and great penetrating power of the sinusoidal current were especially emphasized. An induced current capable of producing equally strong contraction is so painful as to be almost intolerable, and the same is true with current from a static machine. Experiments upon the effect of this current on the sense of taste, the olfactory sense and the auditory sense are now in progress. The effect upon the optic nerve is attributed to its remarkable power of diffusion or penetration. Dr. Kellogg's device for the graphic representation of the curves consists of an electromagnet arranged to form an annular field in which a delicate solenoid is made to move by an alternating current. This solenoid, acting on the short arm of a delicate lever, compels the long arm to scribe its movements upon a rotating cylinder covered with smoked paper. As Dr. Kellogg was unfortunately called away immediately upon the presentation of his paper, no discussion upon it was possible. Dr. John A. Cutter, of this city, next read a paper entitled "Electro-Therapeutics and the Systemic Treatment of Morbid Growths," and Dr. F. von Raitz, also of New York, one on "Lacerations of the Cervix Uteri and Their Treatment."

A "Note upon a New Application of Alternative Sinusoidal Currents in Gynæcology," by Dr. G Apostoli, and "The Electrical Treatment of the Paralysis Due to Acute Poliomyelitis," by Dr. Graeme M. Hammond, were read by title, after which Dr. S. T. Anderson, of Bloomington, Ill., closed the literary part of the proceedings by the presentation of a paper on "The Constant Current in Glaucoma and Cataract." Mr. J. J. Carty took part in the discussion that followed.

In accordance with Dr. Herdman's suggestion, the president appointed the following committees: Committee on Standards of Static Machines, Drs. Kellogg, Cleaves and Massey. Committee on Constant Current Generators and Controllers, Drs. Peterson, Herdman and Newman. Committee on Electrodes, Drs. Rockwell, Nunn and Dickinson.

Dr. Morton, the retiring president, in a few words summed up the proceedings of the Association, and expressed his gratification at the progress made and the bright outlook for the future. The attendance throughout the convention was much larger even than had been hoped, and the papers presented showed an interest in the subject in hand that augured a bright future for the Association itself and great benefit to humanity at large through a more perfect understanding of the proper place and use of electricity in medicine. In retiring from office, Dr. Morton introduced the new president, Dr. Goelet, after whose brief address of acceptance, Dr. Nunn moved a vote of thanks to Dr. Morton for his efficient and untiring work in behalf of the society, and the meeting adjourned.

The next convention will be held in Philadelphia, on Sept. 10, 1893, immediately following the meeting of the Pan-American Congress of Physicians.

EXHIBITS.

In the hall immediately adjoining that in which the convention was held, a number of the leading instrument makers of the country showed electro-medical apparatus in great variety.

Messrs. J. H. Bunnell & Co. exhibited a number of dry battery outfits for physician's use.

Mr. Otto Flemming, of Philadelphia, had on exhibition some portable galvanic batteries with controller and milliamperemeter attached, and a combination apparatus for galvanic and Faradic currents. A portable Faradic battery, with three secondary coils, was also shown, as well as a set of carbon electrodes, of which he is the sole manufacturer.

The McIntosh Battery and Optical Co., the Eastern agents for whom are Messrs. Oelschlaeger Bros., 42 East Twenty-third street, this city, had an interesting exhibit of table batteries and electrodes. An improved Töpler-Holtz machine was also shown, for which some strong claims are made. This machine is the only one of its kind in existence.

The Edison Manufacturing Co. exhibited a number of Edison-Lalande batteries, and a complete standing cabinet for medical use. A phonograph, with a 14-way hearing attachment, was also in operation, and the contents of a number of excellent cylinders were given to the visitors during the course of the convention.

Messrs. Geo. S. Davis, of Detroit, had on exhibition a number of publications upon electrical subjects as applied to medicine.

The Jerome-Kidder Mfg. Co. showed a new form of portable gynaecological coils made for the Electro-Therapeutic Society. Various instruments devoted to this field of service were also shown, as well as cabinets and portable galvanic batteries.

The Ozone Mfg. Co., 47 Liberty street, showed one of their machines in operation.

Messrs. J. C. Vetter & Co., 104 East Twenty-third street, showed their standard milammeters, carbon current controllers, incandescent current adapters, Leclanché dry batteries, etc.

The Ford Surgical Instrument Co., 315 Third avenue, exhibited the Gibson storage battery, for which they are special agents, as well as a large number of electrical instruments. This company make a specialty of getting up special forms of instruments for particular uses.

Dr. H. E. Waite, president of the Waite and Bartlett Mfg. Co., 143 East Twenty-third street, was present with a large electrostatic machine, claimed to be one of the most perfect in existence.

The Law Battery Co. showed one of their electro-therapeutical outfits, for which extensive claims are made.

The Galvano-Faradic Manufacturing Co., of 300 Fourth avenue, this city, exhibited a number of medical batteries, together with battery-cabinets and appliances.

LETTERS TO THE EDITOR.

THE IMPORTATION OF SUBMARINE CABLES.

I HAVE followed with much interest the discussion in your valuable journal on the question of importing submarine cable into America for the United States Government. I quite agree with your correspondents in believing that there is no need to go outside the United States for a cable only seven miles long. At the same time I do not think any American manufacturer could turn out an armored cable forty or fifty miles long as Mr. Marsh suggests. All the factories that I know of in America are inland, or at any rate they are not conveniently situated for water transportation, and the difficulties of storing, handling and transporting a cable of such length would be insuperable.

In the second and third paragraphs of his letter Mr. Marsh goes quite wide of the mark. He is in error in stating that all submarine cables of great length have been laid by foreign companies "generally under subsidies from foreign governments." By far the greater proportion of the submarine cables of the world are owned by English telegraph companies and in the majority of cases government subsidies do not form an important part of the revenue; in any case the subsidies only guarantee a certain amount of government traffic. Most of the cables owned by foreign governments have been paid for outright and form part of the regular telegraph system of the country to which they belong.

It is obviously impossible that a demand can exist *in* the United States for long submarine cables, and as submarine cables are usually laid down in the deep sea it is equally impossible that American manufacturers can be protected by an "import tariff on the finished article."

There is a great deal more in the submarine cable industry than is implied in the airy expression of "putting in a plant." It is an industry that has been built up in all its branches by years of dearly bought experience, and the difficulties of starting an American cable factory, Minerva-like and completely equipped for handling large contracts, are so serious that even the most enterprising manufacturers have been quite content to see American orders for many thousand miles of cable go across the water.

HERBERT LAWS WEBB.

LONDON, ENG. Sept, 19, 1892.

PATENTS ON ENAMEL INSULATORS.

REGARDING enamel rheostats, cooking apparatus, and all other electrical apparatus with conductors imbedded in enamel, we wish to call your attention to a decision of the Commissioner of Patents, copy of which we enclose herewith. As owners of the Morford patents, which we propose to protect, we feel that you are entitled to know our rights in connection therewith, and believe you will respect them regarding any infringements.

P. H. GUNCKEL,
Attorney, Enamel Insulator Co.

CHICAGO, ILL.

(The document sent us is a copy of the decision of the Commissioner of Patents in the case of Morford *vs.* Carpenter, on the appeal of the latter from the decision of the Examiners-in-Chief awarding priority of invention to Morford with reference to the following interference issue: "In an electro-heating apparatus, the combination with the heated surface-plate and the resistance, of a coating of enamel, or its equivalent, securing the resistance to, but insulating it from said plate." The Commissioner upheld the award to Morford.—EDS. E. E.)

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED SEPT. 27, 1892.

Alarms and Signals :—

Circuit Closer for Railroad Crossing Signal Mechanism, I. W. Loy and R. O'Toole, Mechanicstown, Md., 483,231. Filed Nov. 6, 1891.

Has for its object to automatically close a circuit for the purpose of giving a signal on the approach of a train.

Electric Bell, N. H. Raymond, Buffalo, N. Y., 483,309. Filed Aug. 29, 1891.

Employs a porcelain base and an electromagnet whose frame is seated in a recess in front of the base and secured thereto.

Electrical Annunciator, N. H. Raymond, Buffalo, N. Y., 483,310. Filed Sept. 26, 1891.

Employs a U-shaped sheet metal, provided with stiffening wires and having the armature pivoted on one wire and the drop on the wire at the opposite side of the frame.

Conductors, Conduits, and Insulators :—

Electric Cable, T. Guilleaume, Cologne, Germany, 483,285. Filed May 5, 1892.

Employs a strip of non-conducting material twisted about its own axis to form spiral grooves in which the conductors lie.

Coupling for Underground Wires, J. J. Purcell, Washington, D. C., 483,327. Filed Feb. 16, 1892.

Employs two sleeves, one upon each end of the cables to be connected; having respectively right and left hand threads on their abutting ends, and a nut having corresponding threads.

Dynamos and Motors:—

Electric Motor, W. M. Dresskell, Brainerd, Minn., 483,431. Filed June 23, 1891.

Has for its object a motor which may be operated by an alternating or direct current in which the sections at the commutator may be readily removed and replaced without disarranging any of the adjustments of the machine.

Heating:—

Electric Heater, T. Ahearn, Ottawa, Canada, 483,124. Filed April 4, 1892.

Employs a tube of heat-conducting material about which the heating wires are wound, and an outer metallic tube; the annular space being packed with powered fire clay or like material.

Measurement :—

Method of Measuring the Strength of Magnets, C. H. Rudd, Chicago, Ill., 483,168. Filed Nov. 6, 1891.

The method consists in balancing the magnetic field by a counter magnetic field generated by an electric current, which is measured and compared with the current required to balance a standard magnet.

Electric Meter, A. G. Waterhouse, Hartford, Conn , 483,189. Filed January 4, 1892.

A meter in which the current is measured by the collection of gas and its discharge from a receptacle.

Metal Working :—

Process for Electric Welding, C. L. Coffin, Detroit, Mich., 483,423. Filed Dec. 11, 1891.

Consists in heating the metal by an electric current, upsetting each of the heated parts at a point back of the point of welding and not at the plane of junction, and then bringing the parts into contact and passing a heating current, after which the parts are pressed together.

Electric Metal Working Device, C. L. Coffin, 483,424, Detroit, Mich. Filed Dec. 11, 1891.

Employs a clamp for holding the article to be worked and carrying a die and a movable conductor for applying pressure.

Process of Electric Metal Welding, C. L. Coffin, Detroit, Mich., 483,425. Filed Jan. 21, 1892.

Process of electrically welding sheets of metal by supporting over the seam a metal plate, between which and the junction of the two plates an arc is formed.

Process of Electric Metal Heating, C. L. Coffin, Detroit, Mich., 483,426. Filed Jan. 26, 1892.

Consists in simultaneously subjecting the metal at different points to the action of separate arcs whose heating power varies in approximate proportion with the respective cross-sections of the material at the points to which they are applied.

Electric Metal Working, C. L. Coffin, Detroit, Mich., 483,427. Filed Feb. 6, 1892.

Consists of a converter having a broken secondary and means for inserting the piece to be welded within the core of the transformer so as to complete the secondary.

Process of Electric Metal Working, C. L. Coffin, 483.428. Filed Feb. 8, 1892.

Claim: Process of heating metal consisting in subjecting the opposite sides of the metal simultaneously to the action of voltaic arcs alternated in position.

Miscellaneous:—

Means for Controlling the Operation of Mechanisms, H. E. Vineing, Roseville, N. J., 483,272. Filed Feb 27, 1892.

Has for its object to enable an operator at a central station to control any one of a number of mechanical devices independently of the others.

Watchman's Electric Time Recorder, N. H. Raymond, Buffalo, N. Y., 483,308. Filed Aug. 17, 1891.

Thermostat, I. F. Beers and F. C. Beers, Elmira, N. Y., 483,339. Filed March 7, 1892.

A device for regulating the draft of furnaces.

Railways and Appliances :—

Electric Locomotive, N. C. Bassett, Lynn, Mass., 473,204. Filed April 1, 1891.

Consists in so supporting a motor that its armature may be concentric with the axle of the locomotive.

Electric Railway System, A. L. Riker, New York, 483,366. Filed Dec. 22, 1891.

Employs a hollow rail of magnetic material inclosing a conductor also of magnetic material and resting normally on an insulated portion of the interior of the rail, and a magnetic device carried by the car to bring the conductor into electrical contact with the rail and with brushes for collecting the current.

Trolley Track Hanger for Electric Railways, W. Q. Prewitt, Lexington, Ky., 483,388. Filed Oct, 17, 1891.

Consists of two clamping members having an underlying flexible support and a channel between their adjacent edges to receive the track.

Electric Railway Conductor, R. M. Hunter, Philadelphia, Pa., 483,494. Filed Sept. 23, 1886.

The invention comprehends an overhead conductor supported from above and a car traveling beneath and provided with a trolley and arm for collecting current from the overhead conductor.

Switches and Cut-Outs :—

Electric Cut-Out and Switch Box, L. D. McMunn, Cromwell, N. Dak., 483,235. Filed April 5, 1892.

Consists in the combination with terminal plates for the lamp circuit of sliding contact blocks, a lever for operating them, and one or two pairs of dynamo circuit terminals with a short-circuiting bar between each pair.

Electric Snap Switch, S. F. Alden, New Bedford, Mass., 483,316. Filed Feb. 1, 1892.

Comprises four terminals composed of separate vertical plates, the opposite plates being connected, and a rotary shaft and brush adapted to be brought successfully into contact with the terminals.

Telephones and Apparatus :—

Automatic Coin Actuated Telephone, F. Muller, Berlin, Germany, 483,162. Filed Aug. 25, 1891.

Test System for Multiple Switchboards, C. E. Scribner, Chicago, Ill., 483,175. Filed Dec. 5, 1891.

The invention consists in including a condenser in each circuit in connection with the individual annunciator.

Test System for Multiple Switchboards, O. A. Bell, New York, N. Y., 483,506. Filed Sept. 30, 1891.

Employs line spring jacks having two line springs, contact anvils one for each line spring, and a test ring insulated from the line spring; two telephone lines including the springs respectively, a conductor joining all of the test rings, a branch from the conductor to one of the lines after it has included all of its line springs and contacts, and an earth connection to the line to which the branch extends.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

Advertising cheapens the cost of production by increasing the number of goods produced.

THE CARSTARPHEN ELECTRICAL RECIPROCATING TOOL.

THE CARSTARPHEN ELECTRICAL RECIPROCATING TOOL.

AMONG the more recent novel applications of electrical machinery designed to dispense with expensive hand labor, is an electrical "reciprocating tool" invented by Mr. Wm. P. Carstarphen, Jr., of Denver, Col. This tool is designed to do away with the mallet and chisel in the hands of the stone carver, and does its work by delivering a series of rapid blows upon the material to be shaped. For this purpose it is provided with a reciprocating plunger located and moving within two coils of wire through which a direct current of electricity is alternately passed. The current for operating the tool can be supplied from any suitable electrical source, such as an ordinary galvanic battery or a dynamo-electric current which is simultaneously switched from one coil or set of coils to the other by the use of a suitable mechanism located between the two coils, and controlled by the reciprocation of the plunger. The electrical current enters one end of the tool through a revolving swivel, and the rapidity of the strokes made by the plunger is regulated by a button on one side of the tool. In one model, which is a three-pound tool, the stroke can be made to vary from one-eighth of an inch to one inch, with a motion varying from 300 to 600 strokes per minute.

To operate a tool of this size but from four to six volts current are required. This makes it perfectly harmless to the operator, and as the wires enter the tool through a revolving swivel, there is no possibility of the wires becoming twisted while in use. Portable storage batteries 12 x 6 x 6 inches have been made, which are encased in a neat box and intended for operating the tool on scaffolds and elsewhere away from the shop. These have operating power sufficient for a day's work and can be recharged over night at an expense not to exceed 25 cents. Our engraving, reproduced from a photograph, shows the manner of manipulating the tool. With it, the carver or sculptor, instead of dividing a portion of his attention to striking his chisel, can devote his entire attention to the lines which he is following, thus producing more accurate and rapid work. It is estimated that the machine will produce work in one-fourth the time of hand work, and therefore a material reduction in the cost will be secured. We may add that Mr. Wm. M. Clark, Park Avenue Hotel, this city, has charge of the interest of the company in the East.

"THE ELECTICAL ENGINEER'S" EXTRA ON THE LAMP DECISION.

THE ELECTRICAL ENGINEER was the only paper that published last week the full and official text of the Edison lamp decision in the United States Circuit Court of Appeals. A stenographic version published by one of its contemporaries contained nearly 200 mistakes and omissions, many of which were of a most serious nature as confusing and perverting the sense. The official text in the ENGINEER eight page extra issued on Wednesday, was accompanied by a careful synopsis, and gave abstracts also of two other important electrical decisions handed down at the same time. Before Thursday night, over 15,000 of the extras had been printed and mailed. The demand from all parts of the country has continued large down to the present time, the ENGINEER'S enterprise being very generally appreciated.

THE BOGART ELECTRICAL APPARATUS FOR RETOUCHING PHOTOGRAPHIC NEGATIVES.

THE retouching of photographic negatives consists in deepening certain parts of the negative plate, where otherwise too great a quantity of light would pass through in the printing process, resulting in too strong shadows, or to correct mechanical faults or to modify strong natural peculiarities of the individual sitting for a portrait, such as wrinkles, moles and other facial defects or blemishes. The work itself is analagous to what is known as "shading" in ordinary pencil or crayon drawing, and consists essentially in filling in the ground by short parallel strokes of the pencil.

The electrical retouching apparatus consists of a cylindrical case, about the diameter of a thick pencil, and is provided at its end with the ordinary pencil clamp, which receives and holds the lead sharpened to a long point. The pencil clamp is not attached to the holder tube as usual, however, but to a metallic shaft which rotates freely within the holder, and however accurately the lead may be centered, the point, when rotating, will describe a small circle. Thus, if when the shaft is rapidly revolving, the holder be held upright and applied to any surface, a small circle will be the result of each application, the diameter of which will vary with the eccentricity of the setting. If, on the contrary, the holder be inclined at an angle and the point be applied, the holder being moved by the hand longitudinally in the direction of its axis, a looped spiral will result, the length of the loops depending on the speed of translation. If the angle which the instrument and surface make with one another be diminished, then only the under side of the pencil can act, and the result will be short parallel curved lines, whose distances apart depend upon the longitudinal movement. As the instrument is inclined more and more towards the surface, so do these parallel lines become less and less curved, approaching the straight line.

The pencil is rotated by a miniature electric motor attached to the top of the holder and operated by a small two-cell battery in connection with a flexible conducting cord. The entire weight of the instrument and motor is but three ounces. The hand is relieved of this weight even, by suspending the instrument by a fine long spiral spring supported when in use by a hook in the ceiling, or framework of the retouching table. The instrument is the invention of Mr. A. Livingston Bogart, of this city.

ELECTRICAL DEVELOPMENT AT ASPEN, COL.

THE ROARING FORK ELECTRIC LIGHT AND POWER CO., of Aspen, Col., is going in for extensive improvements. It is now building a new plant, designed exclusively for the purpose of furnishing power to the mines. It will use five Brush dynamos of 500 volts and 350 amperes each in its new plant, and will deliver the current by means of 225,000 pounds of No. 0000 copper wire. The dynamos will be driven by five 57-inch Pelton water-wheels, under 356-foot head, giving 250 h. p. per wheel. The water is brought from separate streams by means of a 30-inch pipe line 4,000 feet long, one 24-inch pipe line 3,900 feet long, a wooden flume 16,500 feet long and another 12,000 feet long. The shafting, floor stands and clutches are from the Hill Clutch Works. The iron roof and the traveling crane were furnished by the Berlin Iron Bridge Co. The officers of the company are H. P. Cowenhoven, president; D. R. C. Brown, vice-president; C. E. Doolittle, manager, and C. F. Brown, secretary. We are indebted to Mr. Doolittle, an old reader of THE ELECTRICAL ENGINEER, for these interesting details.

DETROIT ELECTRICAL WORKS.

THE DETROIT ELECTRICAL WORKS have secured the contract for the equipment of the Woodward avenue line of the Detroit Citizens' Street Railway Co., that city, notwithstanding the fact that great effort was made by the other companies manufacturing electric railway apparatus to secure same, and the awarding of the contract was largely due to the satisfactory manner in which the Jefferson avenue line, which was equipped a short time ago, has operated.

In addition to the above contract, the works have lately received an additional order (the sixth) from the Calumet Electric Street Railway Co., Chicago, and have also been awarded the contract for the equipment of the Consolidated Street Railway Company's lines at Salina, Kan.

Notwithstanding the fact that their factory has been enlarged so that the capacity is now three-fold what it was last year, the works are still crowded to the utmost with orders for their standard railway equipments, and also for railway generators.

MR. C. D. SHAIN, 136 Liberty street, in addition to his other agencies, will represent the Sunbeam Incandescent Lamp Co. in Eastern and Middle States. As stated last week, he is now Eastern agent for the Siemens & Halske Co. Mr. Shain is also selling agent for the Weston instruments and the Carpenter enamel rheostats.

A SHORT ELECTRIC STREET CAR AS A FREIGHT LOCOMOTIVE.

THE following data concerning the Short Electric Railway apparatus in operation on the Collins Park and Belt Line Railway Company, of Atlanta, Ga., will be of some interest to our readers:

THE SHORT ELECTRIC RAILWAY COMPANY,
Cleveland, Ohio.

Dear Sir.—The E. T. V. & G. R. R. delivered our generator at the W. & A. R. R. through an error. The W. & A. carried her out to the new water works, 10 miles from the city. Hunting her up and getting her back to the G. P. yards, delayed me in setting her up. Took her out to the power station last Friday evening. Unloaded her and set the base on Saturday. Put her together on Sunday. Wired her up on Monday and started her on Tuesday. The company here did not have an engine and it would have been very costly for me to haul the generator to the power station by wagon. Besides, some parts of the road would have had to be fixed up. In all I believe it would have cost $40 or $50 to haul her four or five miles to the plant. Therefore, I hitched an electric car to the flat car containing the generator and started for the plant. It made a heavy load, but I got there safely. On the steepest grade we went along faster than a man could walk and you know we have some pretty stiff grades on this road, fully 6½ per cent. I think. The motors got pretty warm but not more so than I have seen them during heavy traffic. The work done by them is remarkable and is the talk of the town.

(Signed) R. L. CALDWELL,
Expert in Charge.

Data concerning the trip is as follows :

Pennsylvania Railway Company car No. 5,653, weight....	29,150 lbs.
One Short 150 h. p. generator .. .. " ..	24,000 "
Total weight......	47,150 "

Between the Georgia Pacific Railroad Company and the power station of the Collins Park and Belt Railway Company there is one grade of 5 per cent. and another of 6½ per cent. The distance between the two points is 4½ miles. The motive power was one 16-foot open car body, equipped with two 20 h. p. single-reduction Short railway motors.

JOSEPH M. ZAMOISKI.

MR. JOSEPH M. ZAMOISKI, late of the Warfield Manufacturing Company of Baltimore, has been secured by the Ries Electric Specialty Company, of that city, as the manager of their construction department. The Ries Electric Specialty Company has now gone into the construction work in earnest and found themselves in need of an efficient manager, hence their employment of the gentleman above referred to. Mr. Zamoiski leaves his position as salesman for the Warfield Manufacturing Company, where he had worked up a reputation for himself in the successful installation of electric lighting plants complete. The Ries Company is already figuring on the complete electrical installation of a number of large and handsome buildings.

A $2,000,000 ILLUMINATING COMPANY FOR BALTIMORE.

THE General Electric Company has just succeeded in organizing an electric lighting company in the city of Baltimore, with $2,000,000 capital, whose plant will be unique. The central station will have no less than 10,000 h. p. For the central part of the city the 3-wire Edison system will be used ; for the suburbs, the Fort Wayne alternating system ; while the Fort Wayne arc lights will be used throughout where arc lights are required—all wires will be underground. The company will be under the management of Mr. J. Frank Morrison.

"INVENTIVE PROGRESS—BENEFITS OF THE AMERICAN PATENT SYSTEM."

MR. W. A. ROSENBAUM, the electrical expert and patent solicitor, of the Times Building, New York, has published under the above title a very interesting and beautifully illustrated pamphlet. It is a history in brief of the growth of our patent system, and gives a running account of many of the notable inventions fostered by it. There are group portraits also of patent commissioners and leading inventors, as well as pictures of the Patent Office.

BISHOP CABLE SELECTED FOR THUNDER BAY.

THE BISHOP GUTTA-PERCHA CO., of this city, have been notified that they are the successful bidders for the Thunder Bay cables about which THE ELECTRICAL ENGINEER recently contained so much interesting correspondence. The bids were opened at Washington on September 30, four being received for the six and a half miles of cable required. The Bishop Co. were the highest bidders, and were surprised at securing the contract. Preference would appear to be based strictly on the quality of the product. The Bishop samples were acknowledged to be far superior to the foreign. The Bishop Gutta-Percha Co. are to deliver the cable at Alpena and to furnish splicers, the Government paying the expenses of laying. It will cost a little over $8,000 laid.

SYRACUSE VOLTMETERS AND AMMETERS.

ON account of the great demand for voltmeters and ammeters in which are embodied the desired points of durability, accuracy, economy of power, dead-beatness and good finish, the Electric Engineering and Supply Company, of Syracuse, N. Y., are putting on the market instruments of the magnetic vane type. The principle is that of magnetic repulsion, controlled by a spring of great permanency by means of a large air vane of aluminum. The instrument is made quite dead-beat, and the pointer will come to rest much quicker than in the ordinary instrument of this class. The pointer is furnished with a good sized black dot to render the reading of the instrument possible at quite a distance. High resistance is aimed at in the voltmeters, and low resistance in the ammeters, thereby reducing the consumption of the power to a minimum. It is stated that with a fine finish and an accuracy unexcelled by the commercial instruments, they are worthy of a position upon the finest switchboards, as well as for portable work, and are guaranteed to do good service. They are put upon the market at a moderate price, and the demand for them is increasing daily.

THE KESTER ELECTRIC CO.

THE KESTER ELECTRIC CO., of Terre Haute, Ind., manufacturers of dynamos and motors, and whose advertisement will be found in another column, report a very good trade and say that the call for their incandescent dynamos is greater than ever before. They build all sizes of dynamos from 30 to 500 lights capacity which, owing to the care with which they are made, the high grade of material which is used in their construction and the method of compounding them, give them an efficiency and durability, it is claimed, surpassed by none. During the past summer this company sold a large number of 500-volt motors which are running by power furnished by street railway companies. The slow-speed, high-efficiency and noiseless running of these motors, coupled with the ease and reliability with which they can be operated, has created a large demand for them and they are compelled to run night and day to keep up with orders.

THE FORD-WASHBURN STORAGE BATTERY CAR.

THE storage battery car of the Ford-Washburn Storelectro Company of Cleveland, which has undergone so many successful tests in that city, will be on exhibition during the coming Street Railway Convention in Cleveland, October 19, 20 and 21. The delegates and visitors to the convention are cordially invited to ride on this car and its trailer and thoroughly inspect the working of same. It is believed that a storage battery car with a trailer will be quite a novelty.

C. & C. APPARATUS FOR THE WORLD'S FAIR.

THE C. & C. ELECTRIC MOTOR CO. have recently received an order from the chief of construction of the World's Columbian Exposition for two generators of 110 h. p. each, to be used to furnish current to the electric elevators that have been installed in the Administration Building on the Exposition grounds. These generators are to be in operation during the dedication ceremonies this month.

In addition to these machines, the C. & C. Co. has received orders for five more generators of 110 h. p. each, four of which are to furnish power to motors operated by exhibitors, and the fifth is for furnishing current for light.

NEW ENGLAND NOTES.

THE WAINWRIGHT MANUFACTURING CO. OF MASS. report the following list of sales of feed-water heaters. It will be noticed that one order was for 5,000 h. p. for the Atlantic avenue road in Brooklyn:

Chelsea Cordage Co., Boston, 700 h. p.; B. & M. R. R. Mystic Wharf Elevator, Charlestown, Mass., two 600 h. p. heaters; B. & M. R. R. Mystic Wharf Elevator, one 600 h. p. surface condenser; Massachusetts Charitable Mech. Asso., Boston, two 600 h. p. heaters; Robt. White & Co., Montreal, Can., one 150 h. p. surface condenser; A. F. Smith, Lynn, Mass., one 100 h. p. surface condenser; Ottumwa Electric Railway Co., Ottumwa, Ia., one 500 h. p. heater; J. A. Mumford, Hantsport, N. S., four 200 h. p. surface condensers; Ypsilanti Electric Co., Ypsilanti, Mich., one 200 h. p. heater; Elmira Silk Mills, Elmira, N. Y., one 200 h. p. heater ; Bay County Electric Co., Bay City, Mich., one 700 h. p. heater; Minnesota Iron Works, Soudan, Minn., one 700 h. p. heater; Mahanoy City, Shenandoah, Girardville & Ashland Electric Street Railway Co., Girardville, Pa., one 500 h. p. heater; H. M. Sciple & Co., Philadelphia, Pa., one 300 h. p. heater; Brooklyn and Atlantic Ave. Railway Co., Brooklyn, N. Y., five heaters, 5,000 h. p.; Ashland Electric Co., Ashland, Wis., one 500 h. p. heater; Mutual Compress Co., Montgomery, Ala., one 300 h. p. heater; Lynn and Boston R. R. Co. (second order), one 1,000 h. p. heater.

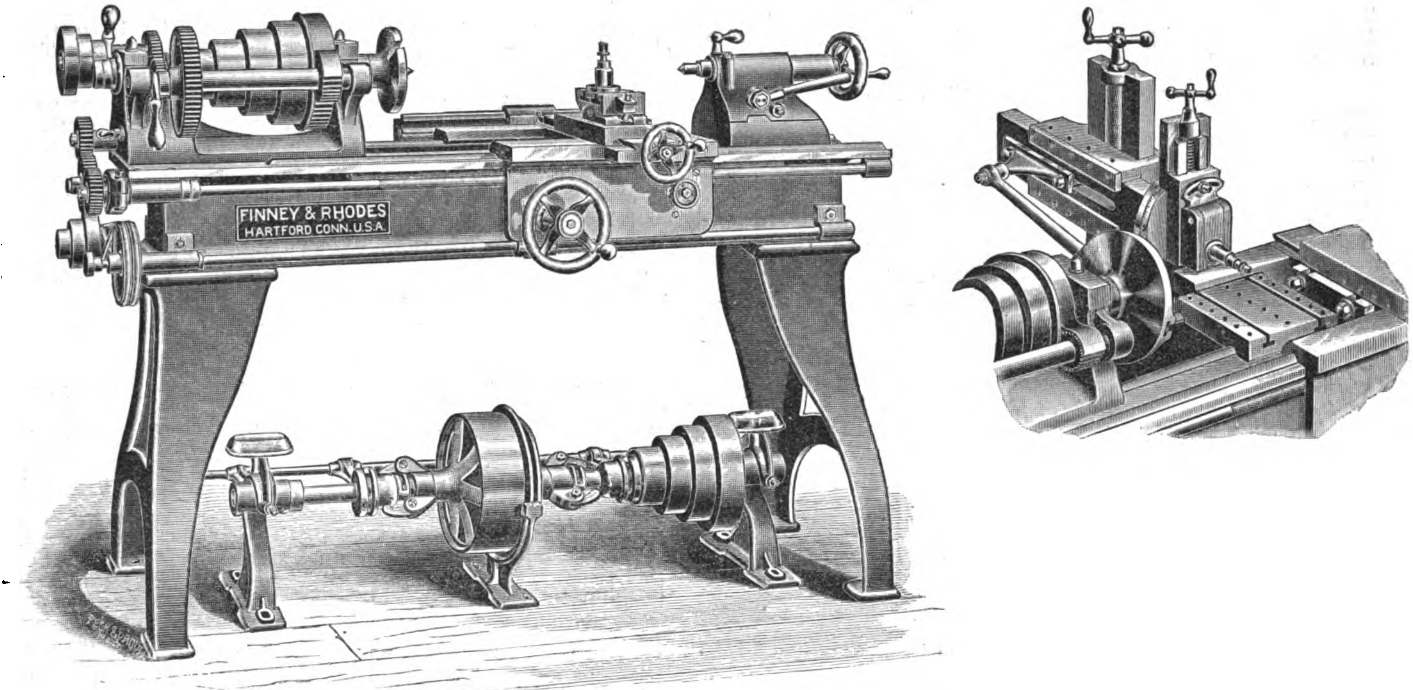
THE NEW 14-INCH GIBB LATHE.

THE value of a good lathe in electrical machine work is too well known to require further demonstration, and to produce a tool adapted to the largest variety of work, Messrs. Finney & Rhodes, of Hartford, Conn., have just brought out a new 14-inch Gibb lathe, illustrated in the accompanying engraving, Fig. 1.

The power gearing of this lathe is brought to the front of the head block instead of to the rear as usual. By this means the power is applied to the spindle downward and against the lifting tendency of the tool in the tool post, thereby largely reducing the tendency to "chatter."

Contrary to the impression that a lathe geared in this manner would interfere and be in the way of the operator, an inspection will show that this is not so. Being amply protected by a shield over the gearing at the face end of spindle it makes a clean lathe to work with as no oil or dirt can fly from the gearing or rub off on the clothes of the worker.

The feed mechanism is driven by small cone pulleys of three steps connecting with groove pulleys carrying straight and cross belts to the feed rod and is entirely independent of the screw and rocker gears which are only used for screw cutting. This feature will commend itself to all mechanics, as it is well known that the constant use of the rocker gearing for turning soon wears them so that they are unfit for good screw cutting. The worm of the feed rod runs in a reservoir of oil, especially provided, so that it is in no danger of cutting and running dry. The tool holder will commend itself at sight. It has the range and action of a weighted lathe carriage, and by the turn of a screw is clamped as though it were one solid piece, and no pressure or vibration can loosen or disturb it when either at its highest or lowest adjustment.



FIGS. 1 AND 2.—THE FINNEY & RHODES NEW 14-INCH GIBB LATHE.

The cross feed screw in the carriage is entirely covered and protected, passing through the centre of the lathe carriage in a direct line to the centre of the taper attachment to which it is connected by a sleeve. At the back of the lathe bed, is cast solid with the same a shelf nearly the full length of the bed, on which is swiveled the taper bar, the slide of which is fastened to the sleeve of the cross feed screw in such a manner that the pull and resistance are all in a straight line. Thus, when the taper bar is set at its greatest range, which is about two inches to the foot, in moving the lathe carriage by hand the resistance is barely felt by the operator.

A shaper attachment designed for this lathe, and shown in Fig. 2, is quite a novelty in this line and is made to fasten to the same table on which is the taper bar, and it receives its motion from a special face plate. It has a stroke of eight inches or less as wanted, thereby increasing the utility of the lathe, especially in small shops or experimental rooms, combining a lathe and shaper in one tool. It can be attached ready for work in less than five minutes.

Another special feature is the single-belt reversible countershaft, built for this lathe, and of novel construction. By the use of this counter, not only is space on the main line of shafting economized, but also the expense of belting and pulleys obviated. A lathe is much easier located if but one pulley is to be placed on the main line of shafting, especially in a crowded shop with interfering counters, than if spaces for two pulleys are necessary, as would be required with the common two-belted countershaft.

These are some of the main features of this lathe, which possesses many other points of excellence. It is a high grade lathe in workmanship, at a fair price.

APPARATUS OF THE CARPENTER ELECTRIC HEATING MANUFACTURING CO.

THE CARPENTER ELECTRIC HEATING MANUFACTURING CO. has been in operation for over a year with a large factory at St. Paul, Minn., engaged in the manufacture of devices of all kinds to be heated by electricity. These include cooking utensils, which are heated by conducting the current directly to the parts requiring the heat, and which lose almost nothing by radiation.

An example of this is the electric flatiron. The surface of this implement is put through a process which extracts from the metal all impurities. There is then spread on the surface an enamel, the composition of which is a secret, and in this is laid a plain iron wire zigzagged all over the surface, with the two ends extended half an inch apart up to within half an inch of the rear edge of the surface. A piece of copper wire is laid on the soft enamel from the rear edge, up to and connecting with each point of the iron wire. Then more enamel is spread on the surface, covering the wire completely.

The two copper points which are laid from the rear edge and connected with the ends of the iron wire are the terminals. The heat in the enamel can be easily regulated to the desired degree. The enamel containing the resistance wire and copper terminals is likewise laid on the inside surface of the pots and kettles, spiders, grid-irons, etc. The articles consume from ½ ampere to 10 amperes, according to their requirements, and being heated very quickly, are thereby able to complete any cooking operation in a very short time. Indeed a breakfast for a small family could be cooked in less than ten minutes from the time the switch is turned on.

MASSACHUSETTS ELECTRICAL ENGINEERING CO.

PLANS for a 700 light incandescent electric plant which will be immediately installed, have just been completed by the Massachusetts Electrical Engineering Company for the Merchants' Woolen Company, Dedham, Mass. The contract was awarded to the Westinghouse Electric Co.

The new town of Rumford Falls, Me., is to have a model electric lighting plant. Both arc and incandescent lights will be supplied from a central station situated by the upper falls, and running from the water power there obtainable. The station will have a capacity of about 200 h. p., only a part of which will be used at present. The work is in the hands of the Massachusetts Electrical Engineering Company.

WESTERN NOTES.

The Railway Equipment Company have leased an extensive factory at Mansfield, Ohio, where they manufacture the Ahearn electric heaters for street railway heaters, cooking utensils and all kinds of domestic heating. In addition to this work they will make a full line of their numerous street railway devices and apparatus. They hold a number of strong patents on numerous valuable specialties for railroad work, the demand for which has been so large that they have found it expedient to arrange for their manufacture on a large scale to meet the growing demand. Mr. W. R. Mason, president of the company, has one of the Ahearn hot water heaters in continual service in his private office in the Pullman Building, Chicago. This, he states, is for making herb tea, but a lingering aroma suggestive of "hot toddy" is noticeable. This he explains as coming over with that lake breeze which has full sway on the front windows of the office.

Electric Appliance Company.—Among some of the latest specialties on which the Electric Appliance Company have built up a nice trade is the C. S. flush face push switch. This is being largely used for fine residence and office work, and frequently mentioned in architects' specifications. Another is the combination branch block, which takes the place of eight ordinary branch blocks. It is made of one piece of porcelain with handsome polished hardwood cover, and is considered far ahead of the old plan of making a crude wooden box and lining it with asbestos. The Ries regulating socket is another specialty which was first handled in Chicago by the Electric Appliance Company, and has now become a standard stock article.

The Bain Electric Manufacturing Co., 49 South Jefferson street, Chicago, will shortly place on the market a new arc lamp with exceedingly simple and novel construction. which is very economical and gives a strong light and is not liable to derangement of any kind. Mr. Foree Bain of this company has recently built some special dynamos for direct coupling on shaft for operation by gas and gasoline engines. These are exceedingly handsome machines and do their work with great economy.

Wm. Hood & Co., 239 La Salle street, Chicago, managers of the Electric Manufacturing Co., Oconto, Wis., have recently made extensive improvements in their office and wareroom to handle the growing trade. A large stock of Brilliant incandescent lamps of all standard voltages and candle powers has been received, and judging from the shipments, business is rushing.

The Union Electric Works, Chicago, are very busily engaged manufacturing the Crowdus primary batteries. These cells are very small and compact for their output and develop full power until the solution is exhausted, when they can be replenished without trouble in a few minutes; special simplified arrangements having been effected for this purpose.

Becker Bros., electrical engineers and machinists, 39–43 West Washington street, Chicago, are handling repair work for all kinds of electric motors and dynamos. They also do business in general experimental work and build special electrical machinery to order. The firm is composed of Mr. C. J. Becker and Mr. O. E. Becker.

The Midland Electric Works are busy in electrical construction and repairing work. Their shop is at 224 East Washington street, Chicago, and is well equipped with tools for all kinds of special work. Mr. Ray Griggs is president of the company, and Mr. C. Samms, secretary and treasurer.

The Chicago Electric Manufacturing Co., 73–75 West Jackson street, are very busy on all kinds of special electrical manufacturing work. Mr. E. R. Crolius, who some time ago accepted the business management, is securing lots of work and running his shop overtime right along.

Mr. Thos. G. Creaghead, formerly of this city, is to be married to Miss Elizabeth Bailie this winter. Mr. Creaghead is at the head of the Creaghead Engineering Co., of Cincinnati, and is doing a large contracting business in building electrical plants in Cincinnati and vicinity.

The Electric Improvement Manufacturing Co. at their Chicago office No. 239 La Salle street, are exhibiting the Perfection electric light desk lamp. This is a very handsome and convenient device and makes the light adjustable for typewriter stand, desk or chair.

W. E. Reid & Co., 339 Rookery, Chicago, are securing a number of orders for the McEwen engines and boilers manufactured by the C. H. McEwen Co. of Ridgeway, Pa. They report that their engines are giving good satisfaction, and repeat sales are the order of the day.

The St. Louis Electrical Supply Co., 809 Locust street, St. Louis, are equipping the Arlington Hotel at Hot Springs complete with bell annunciators and an electric plant of 1,500 incandescents and some arcs.

Mr. C. E. Sargent, Chicago, manager of A. L. Ide & Son, engine manufacturers of Springfield, recently issued a list about a yard long of Ideal engines in use in Chicago. It is a monument to Mr. Sargent's ability as a hustler in the engine business.

The McGuire Manufacturing Co. have sold the Chicago City Railway Co. sixty-one of their improved scale trucks No. 19 F, for use on the lines that they are about to equip with electricity. A number of these trucks will run to the World's Fair.

The Electrical Construction Department of the Columbian Exposition are installing several additional dynamos in their temporary plant for supplying the current required for the extensive illuminations for the dedicatory ceremonies.

Mr. Coleman, of the Electric Specialty Co. of this city, has equipped an electrical carriage, the invention of R. W. O. Watt. This carriage is built with pneumatic tire bicycle wheels, is very light, and the operation is highly successful.

The Pioneer Armature Works, 195 to 199 South Canal street, are exhibiting some very handsome work on rewinding armatures. They handle armatures of all sizes and make a feature of doing firm and reliable work.

The Rice Machinery Co. are moving their office with a largely increased line of pulleys, hangers and power transmission machinery to more extensive quarters at No. 166 to 174 South Clinton street, Chicago.

The Standard Electric Co., 313–317 South Canal street, are closing numerous contracts for standard arc apparatus. Their plants, both arc and incandescent, are giving excellent satisfaction.

Mr. Thos. G. Grier, the well-known electrical engineer of Chicago, is engaged on some special work in connection with the installation of the lighting at the Fair grounds, Jackson Park.

G. E. Horn & Co. are having quite a run on the excellent line of bells they manufacture. They will shortly bring out other valuable electrical specialties.

Knapp Electrical Works have nothing to complain of, and their volume of orders is always on the increase. Safety wire is daily finding new friends.

CANADIAN NOTES.

A Montreal Suburban Railway.—The residents of the towns and villages on the opposite side of the St. Lawrence River to Montreal, have petitioned the Grand Trunk Railway to erect a light bridge structure, capable of accommodating wagons and an electric railway, on one side of the Victoria Bridge and supported upon its piers. Every fall and spring, owing to the state of the ice in the river, this district is absolutely cut off from communication with Montreal except by a railway which does not meet the requirements of local travel; consequently it is claimed that this scheme, in connection with a system of electric railways, would be a boon to the people and a profitable one to the capitalists undertaking it.

Electrical Inspection.—In reference to the system of electric light and meter inspection, which it is reported is to be established by the Dominion Government, the Department of Inland Revenue, which takes charge of such inspections, states that this matter is only under consideration and a bill being prepared, but, at present, the department is unable to give any information as to the scope of the act.

The Ahearn Electric Heating and Manufacturing Company, Limited, is applying for incorporation, with a capital of $250,000, and headquarters at Ottawa, Ont. The object of this company is to supply heat, light and power by electricity and also to manufacture and deal in electrical apparatus.

PHILADELPHIA NOTES.

Mr. William A. Famous, for several years connected with well-known electrical companies of this city, has been appointed Eastern sales agent for the Electric Manufacturing Co., of Oconto, Wis., with office and salesrooms at 103 Vine street. Mr. Famous is one of those untiring workers who with a good article—the "Brilliant" incandescent lamp for example—always meet with success.

Mr. Benj. W. Tingley, secretary of the Heisler Electric Co., is visiting St. Louis and several points in Texas in the interest of the company.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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THE first actual intimation that Columbus had, four hundred years ago, of the existence of the western world, was given him by the feeble glimmer of a distant light, and beyond doubt the first warning that the Caribs had of his fateful approach was afforded them by the dim poop lantern of his own ship. To-day, were Columbus again a European immigrant desirous to discover what manner of country this was, he would be likely on reaching our shores to be greeted first by the broad and cheerful electric beam from Liberty's lofty torch, and then to be gladdened by the airy span of arc lights that glitter between New York and Brooklyn.

During the past week, New York has been endeavoring in various ways and with the help of about four million inhabitants and visitors to do honor to the great and glorious memory of Columbus; and seems to have "celebrated" pretty successfully. The special festivities included a night parade, in which free use was made of electricity; and one of the most noteworthy of the decorative features was the extraordinary profusion of incandescent lights in set pieces, signs, tableaux and structural effects. It would be impossible to say how much money was spent on these designs of which there were literally hundreds all over the city, but the estimate has been made that they represented an expenditure of not less than $250,000, in which sum may be included a large quantity of special arc lighting and the use of a great many search lights in different parts of the city and along the water front. A few notes and sketches are here given of the more meritorious effects.

THE "OCEAN AND CABLE" FLOAT IN THE COLUMBUS NIGHT PARADE.

The Edison Building on Broad street was outlined with sixteen arc lights, eight running down each side, while over the cornice were the dates, "1492" and "1892" in large figures made of incandescent lamps. In the centre of the building were three rows of the electric revolving wheels used in Washington during the recent Grand Army celebration. These had each some conventional design in lamps and, constantly moving and changing as they did, produced a very brilliant effect. On the roof was mounted a search light that played incessantly over the city and the throngs in the streets.

BROOKLYN BRIDGE:—ARC LIGHT, SEARCH LIGHTS, FIREWORKS.

The building of the New York Life Insurance Company was profusely decorated and lavishly illuminated by means of no fewer than 1,080 incandescent lamps. The arrangement of the lights is clearly shown in the illustration. The letters and the dates, 1492 and 1892, were composed of gold-colored lamps, while bands of red, white and blue lamps extended across the entire façade. The colossal portrait of Columbus over the entrance, was framed by 54 white and gold lamps, and the shield was similarly lighted. Current was taken from the isolated plant consisting of three Thomson-Houston generators with a combined capacity of 1,250 lights, driven by two Watts-Campbell Corliss engines. This is used ordinarily to light the entire building. The current was controlled by Johnson switches on each floor and the wiring was such that the rows of letters and borders were divided into halves, each having an independent switch. It is interesting to note that, so carefully was all this temporary work done that there was not so much as a flicker in the entire system, and the engine ran as though furnishing power to an old circuit from which the "kinks" had been thoroughly removed.

The immense store of Bloomingdale Bros., at the corner of East Fifty-ninth street and Third avenue, was illuminated from roof to sidewalk. The main show window on the ground floor represented the Hall of Audience at the Spanish Court what time the future discoverer unfolded his plans to their Most Catholic Majesties. A background of stained glass set off the wax figures, and behind this were arranged the lights, shedding a soft, though brilliant glow upon the rich costumes and decorations.

Outside the building on the second, third and fourth stories were 14 American shields each composed of twenty 16 c. p. lamps, the current for which was taken from the mains on their respective floors, while the whole was surmounted by the legend "1492, Columbus, 1892" composed of characters eight feet in height, each marked out with 30 colored lamps. In front of the main entrance of the building was a large painting of the landing of Columbus, set with a red background, and the frame enclosed by a border of about 100 lights. Each letter and shield had a separate Bryant cut-out on a lightning arrester. The arc lights about the store were all removed for the occasion lest the harmony of the decorative effect should be marred.

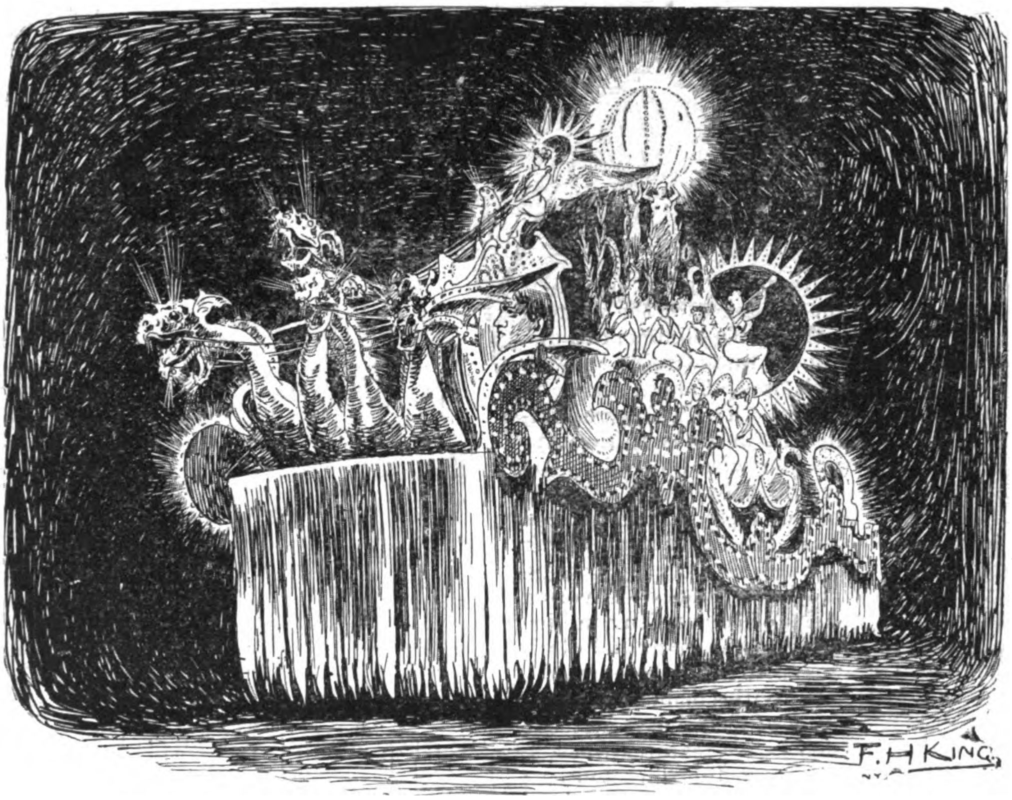
Ehrich Bros., the dry goods merchants, corner Sixth avenue and Twenty-third street, had a very attractive decoration. On the Sixth avenue side were 15 rows of red, white and blue bunting with corresponding incandescent colored lights. These rows ran from the roof coming together at the head of the main entrance, at which place was a fac-simile in painted wood of their trade-mark, 18 feet long and 13 feet wide. It consists of a lion holding in its forepaws a shield with the monogram "E. B." The E. was made of red lights, and the B. of blue. The outline of the lion was in white lights. There were 150 incandescent lamps in this one piece.

At the Union League Club on the northeast corner of Fifth avenue and Thirty-ninth street a beautiful effect was produced by placing rows of red, white and blue lamps upon wide cloth strips, or bars, running vertically the entire height of the building between the windows. There were seven of these panels on the avenue front.

The Metropolitan Hotel at Spring street and Broadway had over the main entrance a large painting, representing the landing of Columbus, surrounded by 48 incandescent lamps. The absence of other decoration, thus concentrating the brilliant colors in the picture itself, produced a very striking effect. Near the Metropolitan, on Niblo's Theatre portico, a search light was perched which did remarkable execution as it flashed up and down the brilliantly decorated thoroughfare and revealed the great tide of humanity flowing between the solid banks of brick and stone mile after mile.

Undoubtedly the most brilliant of the floats in the night procession was the car, "Electra," designed and equipped by the General Electric Company, and well represented in the illustration herewith. It was intended to show Edison's triumph over the Hydra of Darkness, or something of that kind. There were, altogether, on this one float 3,500 incandescent lamps, taking their current from accumulators furnished by the Union Electric Company. and charged from a dynamo of the General Electric Company at their office building on Broad street. These batteries weighed about three tons and added greatly to the stability of the car. Unfortunately the "float" had little of the lightness that the word suggests, being entirely without springs, so that both the lamps and batteries—to say nothing of the human fairies—suffered terribly in their long journey uptown. In the lower part of the city, however, all the effects were seen in their full splendor, and the fairies were still sprightly and unbruised enough to smile on the crowd.

Another float deserving of mention was that entitled "The Ocean and the Cable," in which a tribute was paid to Cyrus Field, the man of whom it was strikingly said that he had moored the New World alongside the Old and thus completed the work of his forerunner, Columbus.



THE CAR "ELECTRA" IN THE COLUMBUS NIGHT PARADE, WITH 3,500 SMALL LAMPS.

The float showed an ocean steamer and two submarine cables dipping under the sea from shore to shore.

That dreadful architectural giraffe, the World Building, presented, for once, an imposing appearance. The immense dome was encircled at its base by a band of white lights, while alternate lines of red, white and blue lights following the ribbed lines, extended to the lantern. More than 200 Edison lamps of 32 c. p. were used, and Mr. F. Shede, the electrician of the World Publishing Company, worked for seven days at an elevation of 300 feet above the ground to complete the work. The wiring was incased in copper-covered Interior Conduit Company's tubing of special make.

Altogether the electric display of the week was a brilliant success. In some respects it might have been much improved upon, and Chicago will doubtless profit next year by New York's triumphs and failures in this field. At any rate it was fitting and appropriate that the electric light should have been thus freely resorted to during the celebration as one of the distinctive advances made by the modern spirit of invention and investigation of which, through all time, Columbus will remain one of the grandest exemplars.

Madison Square Tower.

The New York Life Building.

The World Building.

Columbus and His Globe.

Some Electrical Effects Displayed During Columbus Week.

A NEW USE FOR THE TELEPHONE.

A novel scheme has lately been perfected at the military post, Fort Sheridan, Ill., for use at the rifle range, for the general Government shooting contests, which began the 26th ult. At each of the firing points on the range, the most distant one being 1,200 yards, are located boxes flush with the surface of the earth. In each of these boxes is a spring jack connecting with an underground lead-encased conductor leading to the range house, where all shots are recorded, and also to the targets. When firing is going on from any of these points, a telephone mounted on a tripod is plugged into the nearest box by means of a split plug and flexible cord, establishing immediate communication with the targets, thus giving the scores correctly after each shot. This installation is due to the ingenuity of Capt. Allen, of the Signal Department U. S. A., and E. M. Hatheway, the consulting electrical engineer, of Chicago.

INVENTION AND THE DISCOVERY OF AMERICA.

BY

Edward P. Thompson

While the whole world is honoring the Italian, Christopher Columbus, the electrician should bring forward prominently the name of the importer of the invention of the mariner's compass, Marco Polo, also an Italian, who was the first reported European who saw China, and who discovered Japan, which was not even suspected as being in existence. He and his father were great travelers and discoverers, and their maps and descriptions were noted for accuracy. They were the means of stimulating Columbus in his project, so that in this way, also, Marco Polo was an indirect assistant in the discovery of the New World. Since the importation of the invention, the Chinese have claimed that the property of the lodestone to point north was known to them as early as 2634 B. C., and was used in navigation in the year 300 A. D. Its introduction into Italy was not long before the time of Columbus. It is not known as an absolute fact that Polo was the importer, but there is strong evidence in his favor. One account gives Flavio Gioja the credit of being the inventor, original as far as Europe is concerned; but no evidence is produced. As to the prior Chinese inventor, he must be honored as anonymous.

In conclusion, let us also remember Columbus, not only as a geographical discoverer, but also as a scientific investigator, for it is he who first discovered and partially formulated the law of variation of the magnetic needle during his trans-Atlantic trip.

The unexpected deviations caused the sailors to become discontented and almost violent, because they believed the needle was losing its mysterious power of pointing toward the north star, but Columbus reassured them by explaining his theory of the action.

Prof. J. P. Barrett, chief of department of electricity, of the World's Columbian Exposition, is now in the East rounding up Eastern exhibitors for the Exposition and talking over space thereat, and incidentally attending the dedicatory ceremonies in New York. One of the special objects of Prof. Barrett's visit is to discuss with Mr. Edison the various details and particulars of his exhibit at the Fair.

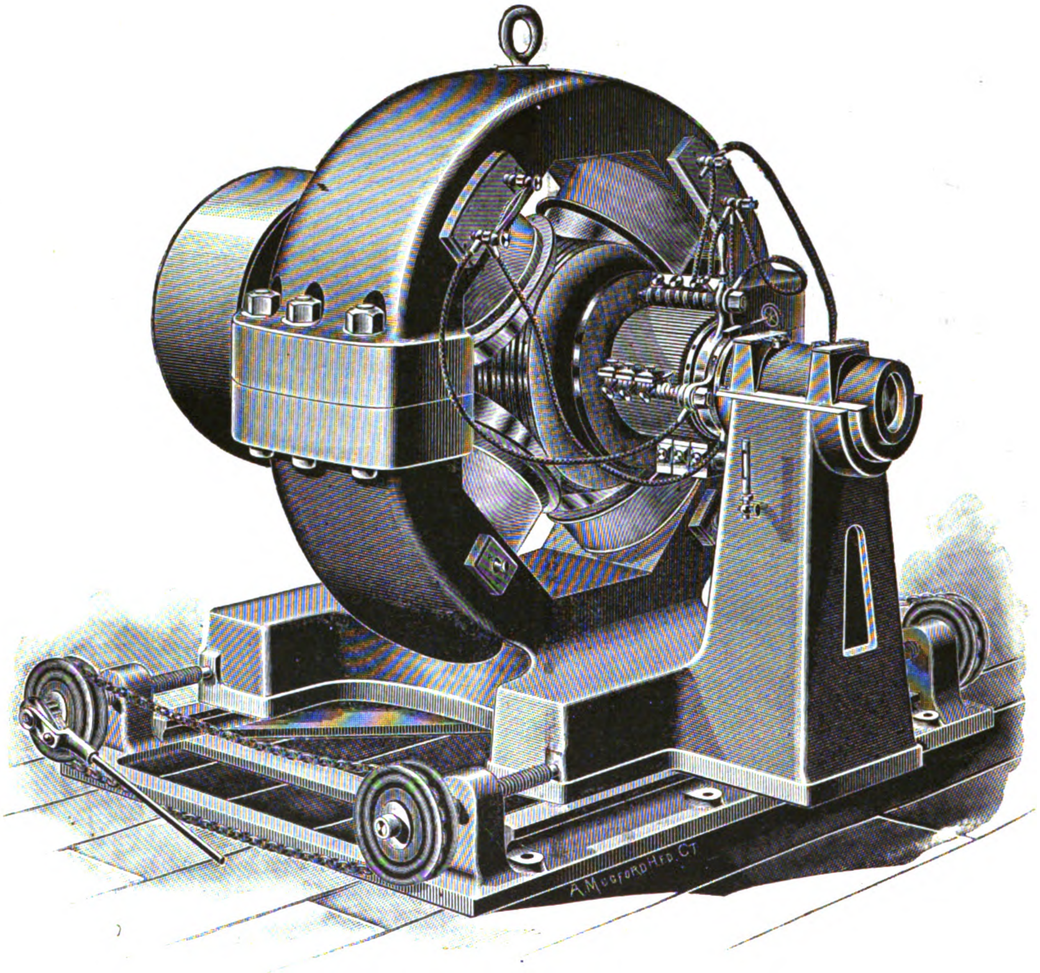
ELECTRIC RAILWAY DEPARTMENT.

THE MATHER GENERATOR FOR ELECTRIC RAILWAY WORK.

BY

Wm. A. Anthony.

The special feature of the dynamos manufactured by the Mather Electric Company, of Manchester, Conn., has been the construction of field magnets without joints, and having a general form as nearly as possible like the natural one of the lines of magnetic force. Following out this principle of construction, the Mather incandescent dynamos, which have been on the market for several years, have been made with cast iron field magnets of the well-known ring form, composed of one piece, and carrying the armature by means of yokes supported by steel bars passing through the poles of the magnets.


A. MUGFORD HFD. CT.

MATHER GENERATOR FOR ELECTRIC RAILWAY WORK.

This form serves a most excellent purpose for incandescent dynamos, and although it seems to those who are not familiar with the mode of winding a difficult form to wind, it is really not so, when wound for low potentials. But for high potential machines it becomes necessary, in order to avoid the strain on the field coils due to sudden changes of potential or breaking of the field circuit, to wind the wires in such a way that no two wires having any considerable difference of potential should be near each other. This necessitated the adoption of a form of field coil that could be wound in a lathe, with a single wire, in layers, and it was this necessity that led to the adoption of the form of generators and motors here illustrated. It was deemed very desirable to retain as far as possible the special features of the incandescent machines, and to this end designs were made to cast the field magnets in one piece, or, if joints are used at all, they are made by a cylindrical piece fitting into a hole bored in the casting and presenting a very large surface of contact so as to reduce as far as possible the magnetic resistance of the joints; and the machine has been so constructed that there are exactly the same joints in each of the magnetic circuits. By this construction there is obtained a perfect symmetry of form in the several magnetic circuits of any one field magnet, and the different coils of the armature all pass through precisely equal magnetic fields. As a result of this arrangement, there is absolute freedom from sparking at the commutator. In the four-pole machines, the armatures are so wound that there are only two paths for the current, but, at the same time, the winding is such, and the commutator so constructed, that opposite bars are joined by a cross-connection, and either two or four brushes can be used at pleasure.

The speeds of the various machines have been adjusted to the sizes of the armatures. The faster a generator or a motor runs, the greater is the output to be obtained, and the limit of speed is entirely a mechanical one. In designing these machines, it has been the aim of the Mather Company to use as high a speed as is consistent with good mechanical principles, and they believe that the speeds adopted will be found in every way more satisfactory than anything slower. Besides the advantage of greater output, the smaller number of windings upon the armature running at a higher speed presents very many advantages in smooth running at the commutator.

A very important factor in the construction of large machines is the quality of the sheet iron of which the armatures are made. Upon this the Mather Company have made a great number of experiments, testing all their iron in various ways, but especially by building up armature cores of half of one kind of iron and half of another, and running these armature cores, before they were wound, in an excited field. This tests the iron under exactly the conditions to which it is exposed in practice, and if one end of the core was found to heat more than the other, the iron which heated less was, of course, the better iron. By such experiments as this the Mather Company have at last found an iron which can be used for armature cores of 24 and 30 inches diameter, running in intense fields, and at speeds of 400 or 500 revolutions, with very little heating. This reduces the unknown losses in the running of the dynamo to a minimum, and the $C^2 R$ losses in the winding of the armature and field, which can be known to a fraction, become the greater part of the total loss when the machine is doing work.

The Mather Company claim a machine in which all the magnetic and electrical parts are absolutely balanced, a machine which will run at a perfectly safe and manageable speed, and gives a large output for its weight; which runs with absolute freedom from sparking at the commutator under great variations of load, and has an efficiency at least as high as, if not higher than, any other similar machine in the market. The sizes of machines constructed for railway generators are 50, 75, 120, 180 and 225 kilowatts capacity. The last has six poles; the others are four-pole machines. The same principles of construction apply to all.

THE ELEVATED ELECTRIC ROAD FOR LIVERPOOL.

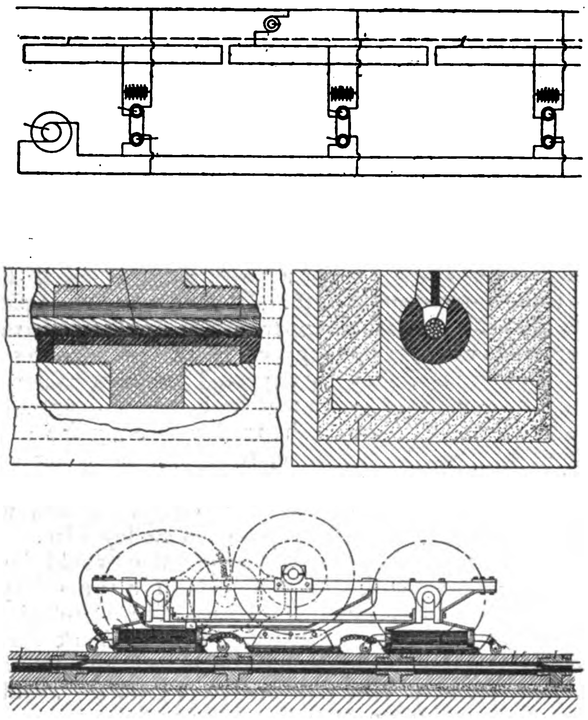
We have already published some details about the elevated electric road which Liverpool is soon to have, running parallel with the docks a distance of about six miles, with sixteen stations very much after the New York model. It is to be worked by electricity, generated at a power house about the middle of the line. At this station are four engines, each capable of working up to 400 indicated horse power, and each driving an Elwell-Parker dynamo. The current will be carried by a steel conductor, placed on porcelain insulators, supported upon cross-timbers between the rails of each track. Hinged collectors of cast iron, sliding upon this conductor, will make the connection. The motors are not placed upon a separate locomotive, but are carried by the passenger carriages.

Two carriages, each seating fifty-six passengers and provided with a motor at one end, will constitute a train. The carriages are to be so coupled as to give a motor at each end of the train, and the motors will be so connected together as to be controlled from either end by the driver, who will always change ends upon arrival at a terminus. The driver will carry a key, without which the motor cannot be operated. All the carriages will be alike, but they will contain compartments for two classes of passengers. A train loaded with passengers will weigh about forty tons. The carriages will be lighted by electricity and fitted with the Westinghouse brake. The total cost of this railway, including equipment, will not exceed $425,000 a mile.

THE RIKER CLOSED CONDUIT RAILWAY SYSTEM.

The main difficulty encountered in the attempt to use underground systems is attendant on the use of an open conduit, and many efforts have been made to overcome this disadvantage.

It has been proposed to carry the service conductor in a conduit closed from end to end and to make electrical connection between the same and an external conductor by lifting *seriatim* a series of pivoted contact-pieces, the lifting of these contacts being effected by means of magnets carried by the car, and also to inclose the conductor in a conduit above which is a magnetic rail, which, when magnetized, inductively lifts the conductor into contact and allows it to drop by gravity after the car has passed.



Figs. 1, 2 and 3.—Riker Closed Conduit Railway System.

Mr. Andrew L. Riker, of this city, has recently devised a system in which the working conductor is loosely laid in a tube made wholly or in part of magnetic material. It is, however, in its position of rest or non-action, electrically insulated from the tube, by lining the bottom of the tube with insulating material. The upper surface of the conduit is exposed above or about flush with the ground between the two rails. The poles of the lifting magnet are arranged to make contact with the surface of the conduit, and thus to magnetize the latter. The poles of the magnets may be in the form of brushes, making a sliding contact with the magnetic tube or in the form of wheels to roll thereon. Under the influence of the magnets that part of the inclosed conductor which lies beneath them is attracted to the top of the conduit, and thus makes electrical contact, falling back again when the car has passed. It is of course necessary that the conductor or cable be composed of iron wires or have an iron core, so that it may respond to the attraction of the magnets. The surface of the magnetic tube is galvanized for the purpose of preventing rust and also to prevent the conductor from sticking to the top of the conduit.

GUARD WIRES FOR ELECTRIC RAILWAYS.

BY

Frank B. Rae

In the construction of trolley lines for electric street railways it has become the practice to erect parallel wires immediately above the trolley lines for the purpose of catching and preventing telephone, telegraph and other bare conductors, which might fall, from coming in contact with the trolley line. These guard wires are usually placed upon span wires attached to the trolley line poles about 10 to 12 inches above the span wires carrying the trolley lines. The guard span wires are usually insulated from the pole and are threaded upon the ordinary porcelain insulator, upon which the guard wire rests or is suspended, and is thus insulated from the span wires.

These guard wires are erected, as a rule, only where foreign wires cross the trolley line, or in the centre of the town where other lines may be strung across the railway conductors. They do not usually form a complete system, nor are they connected electrically with the power station. There is, therefore, no provision for determining whether the guard wires have not accidentally become electrically connected with the trolley line, or with some other wire of even higher potential, and that they offer any real protection to foreign wires or to the apparatus at the end of them seems to be a question of faith. In addition to the protection to the railway station apparatus, or to the apparatus of telephone or other company which the guard wires are supposed to furnish, they are expected to protect persons or animals from shock by contact with the hanging end of a broken wire, held clear of the trolley lines by the guard wires; or to protect telephone, telegraph or other companies' wiremen in stringing wires across the railway circuit. Under such circumstances a charged guard wire would be even more dangerous than the trolley wire.

It would seem that the better practice would be to ground the guard wires, and to depend for the safety of apparatus upon limit switches or fuse wires at telephone, telegraph and other centres of distribution. Workmen engaged in stringing wires would be careful to keep their work clear of guard wires known to be grounded, and in event of their making contact by their work between the grounded guard wire and the trolley line, that portion of wire making such contact would be burned in two; or, if the wire was sufficiently large, the street railway limit switch would operate; but the better ground offered by the guard wire would protect the workmen. If it is thought that the grounded guard wire presents any danger to workmen upon the trolley line, the guard wires could be divided into sections and readily disconnected from the ground upon the section where repairs to the trolley line might be necessary.

It would seem, too, that the grounding of the guard wires would offer protection from lightning by providing a continuous lightning arrester where it would be most effective, and that this latter consideration is, perhaps, the best argument to advance in favor of grounding guard wires. Some 14 years ago, while engaged with the Western Union Telegraph Company as electrician for the Pacific coast division, great trouble was experienced in the operation of wires across the plains by reason of the static charge upon the lines. This difficulty was almost entirely overcome by using one of the wires as a ground wire, making frequent connection with an earth plate at the base of the poles. The so-called static effect upon overhead wires increases with their distance from the earth; it follows that if the earth can be placed near the line, the static effect would be decreased, and this is practically accomplished in electric railway construction by grounding the guard wires.

THE COMPARATIVE EFFICIENCY OF THE COMMUTATED FIELD AND THE EXTERNAL RESISTANCE FOR CONTROLLING RAILWAY SWITCHES.

BY

Harold P. Wellman.

I was surprised, upon reading Mr. Thorburn Reid's article upon the above subject,[1] that he should presume to decide so important a question, as the comparison of the most general and successful methods of railway motor control, with so little and so weak argument. And after carefully reading this article, I can find no comparison of the two methods.

Mr. Reid's argument can be summed up as follows: He assumes a motor having a certain resistance in circuit, and by doubling the number of field turns he increases the field strength by 20 per cent., thus decreasing the speed. And now, from the fact that he can get back to the original speed by decreasing the resistance, and that the current necessary with the increased field is less to produce the required torque, he concludes that he has decreased the loss and demonstrated the higher efficiency of the commutated field. That the resistance necessary to restore the speed and complete this questionable cycle *is less*, is an argument in favor of external resistance, *i. e.*, we should use an intense field.

This reasoning of Mr. Reid also only applies to decreasing the speed, and how he would argue for an increasing speed, I dare not speculate on; but the same reasoning would give an increase of current and resistance together with a weakened field.

This would increase the $C^2 R$ loss, and prove its inefficiency for high speeds, which is another point for the external resistance; for if by increasing the field the efficiency is increased, as shown by Mr. Reid, then as there cannot be two points of maximum economy, the only way to reach it is by maximum field strength, *i. e.*, that used with external resistance.

Assume as Mr. Reid did, two motors with the turns in field, speed, current, and resistance in circuit the same, this latter being made by the resistance of field coils in one case and the resistance of field coils plus the external resistance in the other. Now, in order to increase the speed, we, for instance, reduce the distance in circuit to one-half. Then the motor with the external resistance will increase its speed and decrease the loss to $C^2 \frac{R}{2}$ While with the motor with the commutated field the same change in resistance would give a corresponding increase in speed; but it also gives a weakened field requiring an increased current, $c_1 = c\, n$, (n being a factor depending upon the saturation, but always greater than unity). Thus leaving the loss, $c^2\, n\, \frac{R}{2}$, which is of course greater than the loss by external resistance, which was $c^2\, \frac{R}{2}$.

Therefore I claim that the method of control by external resistance is the more efficient, which is the reverse of the stand taken by Mr. Reid.

And again, while the commutated field *does* give a varying current, this current can never be *less* than required with external resistance, but will be *equal* to it only at minimum speed and maximum field as used with external resistance. Hence the line loss is *greater* and the plant efficiency *less* than claimed by Mr. Reid.

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[1] The Electrical Engineer, Sept. 21, 1892.

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VOL. XIV. NEW YORK, OCTOBER 19, 1892. No. 233.

The electric motor of to-day represents a great advance over the electric motor of last year.—John N. Beckley.

THE ADVANCE OF THE ELECTRIC RAILWAY.

PERHAPS it would be hardly going too far to say that the convention this week in Cleveland is an electrical one. It is true that the American Street Railway Association contains in its large and influential membership a good many important cable and horse railroads. It is equally true that the officers of the Association do all that they can to secure a discussion of all the questions that pertain to street railway construction and operation. But the logic of events is altogether on the side of electric traction, and the most hurried glance at the programme reveals the fact that the subjects which interest the majority of street railway men when in convention assembled are those that deal with electricity.

As a matter of statistics it would appear that electricity is running about 500 street railways in the United States and Canada, a gain of nearly 200 in two years, and fully equal to half of the total street railway system of America. The investment in these roads has passed the $200,000,000 mark, but gives no sign of falling off to a lower rate of increase, for it was only in February, 1891, that the investment was estimated at $50,000,000. These roads are operating at least 12,000 cars, or two to every mile of track. These are wonderful figures of growth since the time when the present writer compiled in 1887 the first American electric railway statistics and could present only the slim total of thirteen roads, some of which were in reality mere experimental stretches of track with but a couple of cars on them.

Such figures as those just cited as giving the status of the industry to-day are in themselves the only vindication that is necessary for the much-abused trolley. They are practically trolley figures, for conduit roads do not exist in this country, and storage battery cars may be counted on the fingers of two hands. Let the trolley, then, have its due meed of praise and credit.

But it is at such seasons as this that one may well inquire as to the trend of things. Is it to be all trolley and always trolley? Hardly. The conduit road is much nearer commercial perfection than it ever was before, and the storage car to-day has reached the point where it can be run by anybody willing to foot the bills. There are, moreover, in the field to-day storage battery systems that have in them so many elements of higher economy and advantage that, in view of the public clamor for them, it is difficult to see how they can be kept back from general adoption.

There are other fields that electric traction is beginning to occupy which are legitimately within the field of discussion of the Cleveland convention, although no provision has been made for them on the programme. The industry has made three new departures quite recently. It has annexed the domain of underground passenger traction in London; it has attacked the problems of elevated railway work in Kansas City, Baltimore and Liverpool, and in more than one American State it has measured itself against the steam railroad for cross-country work. Either of these departments is large enough for all the talent and money and energy now available, while combined they present opportunities the like of which have never before been seen in electrical application.

THE LAMP DECISION.

LAMP manufacturers, lighting companies and consumers are looking forward with much interest and, in some cases, in our judgment, with undue apprehension, to the adoption of a general policy by the General Electric Company in respect to its legal rights under the decision of the United States Appellate Court sustaining the Edison incandescent lamp patent.

Neither alarm nor apprehension seems warranted by the present state of the case. In September, 1886, THE ELECTRICAL ENGINEER said:

> At present there is apparently not sufficient control of fundamental features of arc or incandescent lamps, or of dynamos, by virtue of patented inventions to justify any material taxation of the business of lighting, in the way of royalty.

Since then three considerable electrical patents in the domain of lighting have been sustained by the courts—the Thomson regulator patent, the Brush double-carbon patent and the Edison incandescent lamp patent. Neither of the first two seems to have hampered seriously the production of satisfactory dynamos and arc lamps by companies and firms outside of their protection; and although the Edison decision is more comprehensive in its scope, we have sufficient confidence in the ingenuity and sagacity of American inventors and leaders in electrical industry to believe that even a drastic policy on the part of the General Electric Company could not, for any considerable period of time, prevent the manufacture, sale and use of incandescent lamps.

But a much more gratifying element in the situation lies in the fact that there are good reasons for believing that after due consideration the General Company will find it more profitable, and therefore more expedient, to adopt a general policy of moderation and conciliation than to try to enforce peremptory measures against infringers. Under the decision of the court there can be no doubt of their right to prosecute infringers of the second claim of the Edison patent; but the situation is so complex that such a policy, over the whole field, is hardly to be expected. The pre-existing contract relations of the Edison and Thomson-Houston companies with local lighting companies alone constitute a serious obstacle to any summary stoppage of the supply of lamps to such operating companies as are not using the authorized lamps. Moreover, the capacity of the lamp works controlled by the General Company is not sufficient to supply the entire demand. It will surely not benefit the company to reduce the supply below the wants of the public.

A further circumstance indicating a policy of moderation on the part of the General Electric Company is to be found in the probably short period remaining to the patent. It is thought, in view of decisions in similar cases, under section 4887 of the Revised Statutes, that the Edison patent will expire November 10, 1893, the date at which the English patent for the same invention will terminate. Under the incentive of the patent alone, if so short lived, the owners of it would hardly deem it a good investment to expand their lamp works to a capacity adequate to supplying the entire demand of the country.

Many lamp makers will find some hopeful indication of their immunity from serious penalty for past infringement in the remark reported of Judge Wallace, July 23, 1891, during the hearing of counsel for the Edison Company and the United States Company in the matter of settling the terms of the decree upon the decision of July 14.

> "His Honor said he thought that the greatest cloud that hung over the patent was in its claims—in the language of the patent itself. He did not much blame any infringer for assuming that he could go on and make any sort of an incandescent lamp without fear of that patent."

On the whole, it would seem that the General Company would best subserve its own interests and that of the public by establishing so moderate a license fee or royalty as to enable all reputable makers of good lamps to continue their business, and by so regulating prices as to preclude temptation to the production of inferior lamps.

STEINMETZ ON THE LAW OF HYSTERESIS.

In last week's issue we printed an abstract of Mr. Chas. P. Steinmetz's paper read before the American Institute of Electrical Engineers. This paper, viewed from a purely scientific standpoint, may be considered to be probably the most important which has been presented to that body of late years. In his previous work on this subject Mr. Steinmetz had already given a glimpse of the direction in which he was working, and in the present paper he has practically accomplished for the magnetic circuit what Ohm did for the electric. Ohm's law represents the energy function of electric circuits, by giving the loss of energy in an electric conductor as a function of the electric quantities. In an analogous way Steinmetz's law of hysteresis gives the energy function of the magnetic circuit in its most general form, showing the energy consumption to be independent of the absolute values of magnetization, and only determined by the amplitude of the magnetic variation, being proportional to the 1.6th power thereof, with a coefficient of proportionality η.

But the importance of Mr. Steinmetz's latest work is still further enhanced by the reduction and explanation of all the various phenomena of the magnetic circuit by the aid of only three constants, namely, α, the coefficient of magnetic hardness; σ, the coefficient of magnetic saturation, and η, the coefficient of magnetic hysteresis. He thus finally brings the magnetic circuit within the reach of analytical treatment, in the same way that the electric circuit has been mastered by Ohm's law.

Besides the demonstration of the law above mentioned, the paper is noteworthy on account of the very exhaustive treatise which it embodies on all the different magnetic materials, extending from sheet iron over the entire range to magnetite and even amalgam of iron. Besides this, we are given valuable information on the various methods of observation employed, on the phenomena of alternating and pulsating magnetism, on the theory of demagnetizing by means of alternating currents, etc.

In Mr. Steinmetz's paper we also find the first exact definition of the looped curve of hysteresis, namely, the energy expended by the magnetomotive force during the variation of magnetism. Ample proof is also presented that the assumption that this looped curve represents the energy wasted in the iron by molecular friction is erroneous, and that under certain conditions this loop may represent much more or much less energy than that expended by molecular friction. Mr. Steinmetz also points out an apparent error in the fundamental equations of Ewing's theory of molecular magnets, and gives the correct equations of equilibrium of molecular magnets, which show that the fundamental equations of magnetism are closely dependent upon the law of probability of molecular distances. He thus holds out to us the hope of our obtaining a full understanding of the phenomenon of magnetism in the near future. A full appreciation of the value of Mr. Steinmetz's paper, covering 109 pages of the Institute's *Transactions*, can indeed hardly be obtained without a close study of it.

The Westinghouse Electric Industry.

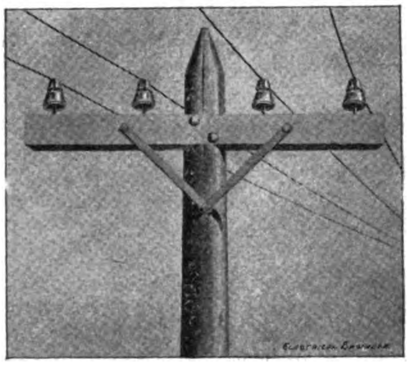
A LARGE portion of our space is devoted this week to an article descriptive of the great electrical industry that has been built up at Pittsburgh under Westinghouse auspices during the past six years. The record and exhibit are interesting in many ways, and are entirely creditable to those who have been associated with the creation and development of this great enterprise. It is curious that a company which came so late into the lighting field should have found so vast an area untouched, as it did, in the alternating system; and, be the revolutions of time what they may, Mr. Westinghouse is entitled to the praise due an electrical pioneer for his foresight in this direction. As much may be said for his quick appreciation of the work of Nikola Tesla, his energy in developing and perfecting electric railway apparatus, and his advanced position in regard to the long-distance transmission of electric power.

A Visit to the Westinghouse Electric Works at Pittsburgh.

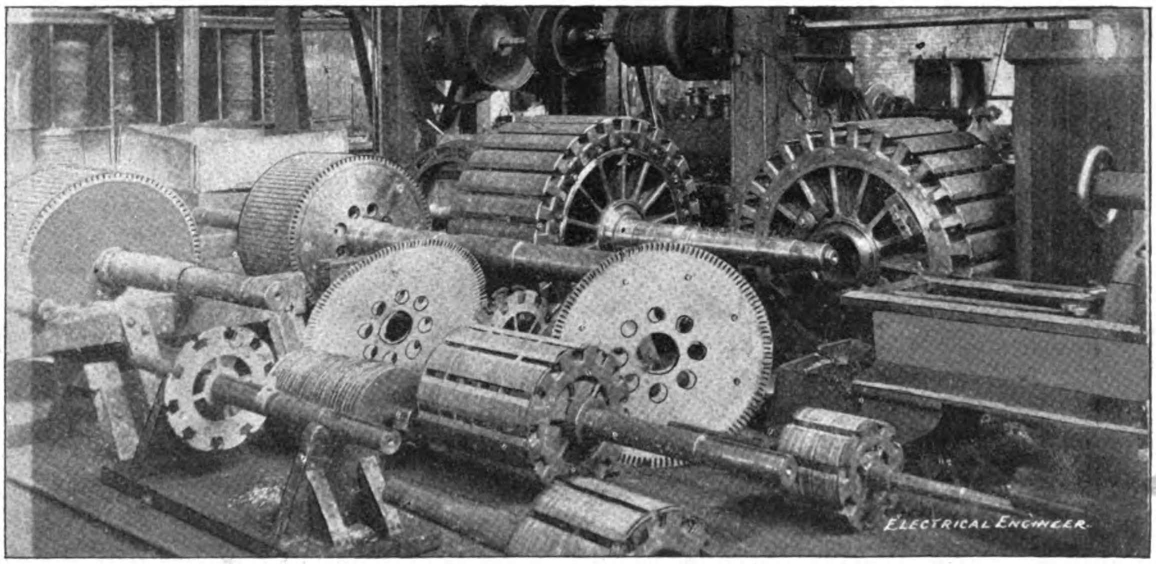
By

Jos. Wetzler.

I.



THE organization of the Westinghouse Electric Company in 1886, laid the foundation for an industry of which until that time very little was known either in the city of Pittsburgh or, for that matter, even in the United States. Until the Westinghouse Company entered the field of electrical manufacture, the direct-current system of incandescent electric lighting was the only method generally practiced. Owing to the many inherent disadvantages and limitations of that system for covering large areas, the introduction of incandescent lights had been very slow, and it may be truly stated that it is in no small measure due to the energetic efforts of the Westinghouse Company and the wonderful success of their alternating system that America is now the great electric country of the world. Previous to the introduction of the Westinghouse electric lighting system, incandescent plants were few and far between.



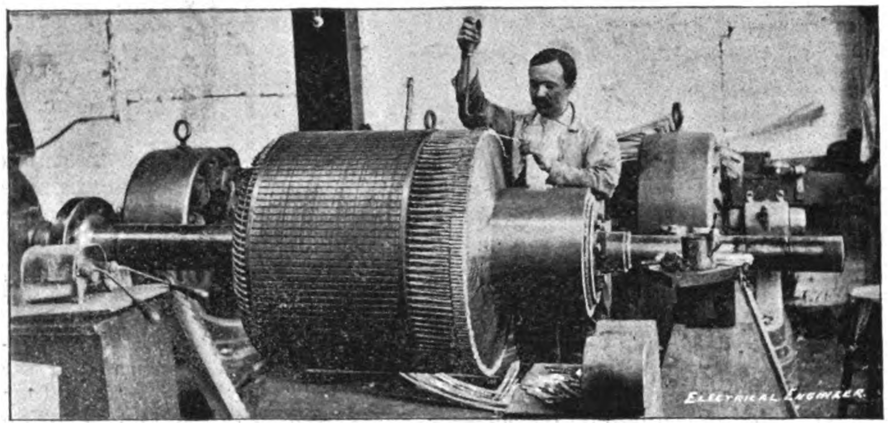
ALTERNATING AND DIRECT CURRENT ARMATURE CORES—WESTINGHOUSE WORKS, PITTSBURGH.

It was a very costly undertaking to establish a large central station and equip it with direct current apparatus having sufficient capacity and range to cover a city or town. Hence the incandescent light was, until 1886, only used by rich corporations, or in municipalities where thickly-populated districts warranted the establishment of a plant. Immediately upon the advent of the alternating system, electric lighting was brought within the reach of everybody in small and large towns, due to the fact that the current can by that system be carried a long distance without the expense of the heavier and more expensive copper wire needed for the direct current.

A demand was therefore at once created for the establishment of central station electric lighting plants such as had not been known before. Thus it came about that within four years the Westinghouse Company installed its apparatus in nearly four hundred cities and towns all over the world, and at this writing there are every night more than a million incandescent lamps burning throughout the world which obtain their current from Westinghouse alternating current generators—apparatus that has all been manufactured in the city of Pittsburgh. It can be readily seen, therefore, that through the Westinghouse Electric Company an influence has been exercised over one of the most important industries in this country, the results of which are of the utmost benefit and value to the whole industry.

As has already been stated, this company was organized is 1886. It grew out of a department of the Union Switch and Signal Company. The new corporation was capitalized with the sum of $5,000,000 and started to work. The company installed its first central station plant in Buffalo, N. Y., and for some time this was the focus of interest for the electrical public of that period. The successful operation of the Buffalo plant established the fact that an electrical system for the distribution of incandescent lighting had been put upon the market which had no equal for central station plants, intended to serve large areas.

Another feature of the Westinghouse system, and one which greatly enhanced its popularity, consisted in the excellence of the apparatus. Simplicity and durability of construction, with the highest efficiency, are made the paramount considerations in the manufacture of one and all of the apparatus of the Westinghouse Electric Company. The result has been that the reputation of the system soon grew worldwide. Demands for its apparatus came, within the first year after the establishment of the company, from England, China, Japan, the West Indies and other foreign countries. One of the Westinghouse plants in England is situated in the heart of London and has a capacity of 50,000 incandescent lamps.


ELECTRICAL ENGINEER.

Soldering Armature Wires to Commutator of Railway Generator.

In 1888 the company made another great step in the further development of its system by the introduction of devices for measuring the electric current as consumed by the lamps. This device is the Shallenberger alternating current meter, the commercial advantages of which appealed at once to every central station manager. These meters are now utilized in measuring the current for nearly one million 16 c. p. incandescent lamps. Close upon the introduction of this meter followed the Westinghouse alternating current arc light system, in which a number of advantageous features had been developed, both in the current generator and in the lamp. The Tesla rotary phase motor was also taken up, and with it came in rapid succession the Westinghouse electric street railway system and the system for the long-distance transmission of power. In both these fields opportunities existed, which offered the greatest possibilities for a manufacturing company equipped with a producing capacity like that of the Westinghouse Company.

To give an approximate idea of the different apparatus the Westinghouse Electric and Manufacturing Company manufactures today, the following facts may prove helpful: The company manufactures alternating current apparatus for central station electric lighting plants from 500 to 10,000 16 c. p. light capacity; alternating current motors developing from $\frac{1}{8}$ h. p. to operate a fan, up to 500 h. p. for the operation of mining and mill machinery; direct current motors for the operation of electric street railways from 15 h. p. up to any capacity desired, and direct current power generators from 80 up to 1,000 h. p.

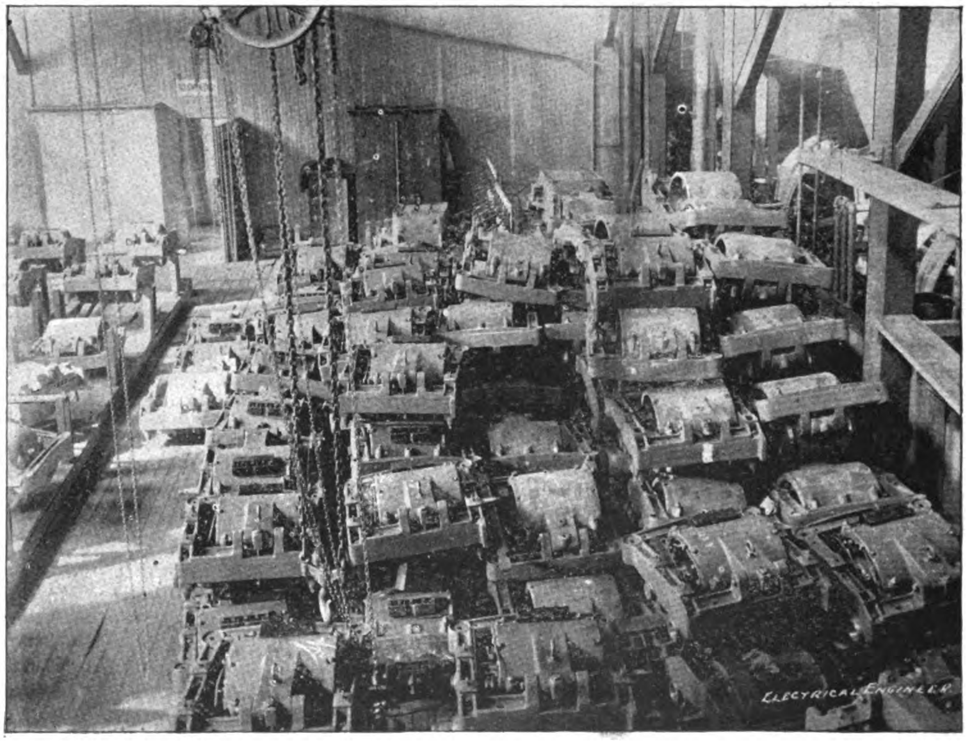
In addition to these machines, the company also makes all the apparatus used in the complete equipment of central station plants, the complete equipment for the installation of an electric street railway power plant and the complete equipment for the installation of an electric power plant for the operation of manufacturing establishments.

The Westinghouse Electric and Manufacturing Company owns a factory in New York City, and one in Newark, N. J. In the latter city the company manufactures direct current motors of all sizes and power; also direct current generators used for the operation of isolated plants, such as are installed in hotels, office buildings, apartment houses, theatres and small manufacturing establishments.

In addition to these exceptional manufacturing facilities, it owns and controls nearly one thousand important patents relating to all branches of the electrical industry.

II.

After this necessarily brief outline of the history of a company whose work is standard in both electrical and mechanical design, we propose to take the reader through the works in which is manufactured the apparatus which has found its way to nearly every town and village in the country. Following the necessary order in which material for such establishments takes its course, we find on the ground floor the office of the purchasing agent through whose hands all orders for the purchase of material and supplies of whatever nature must pass. Besides the chief a number of assistants are required to properly attend to this work, which, in a factory of this nature, daily requires many tons of material of every conceivable nature. From the office of the purchasing agent a few steps lead us to the domain of the storekeeper where all the supplies entering the building are registered and where all orders and requisitions from the



One Corner of the Railway Motor Assembling Department.

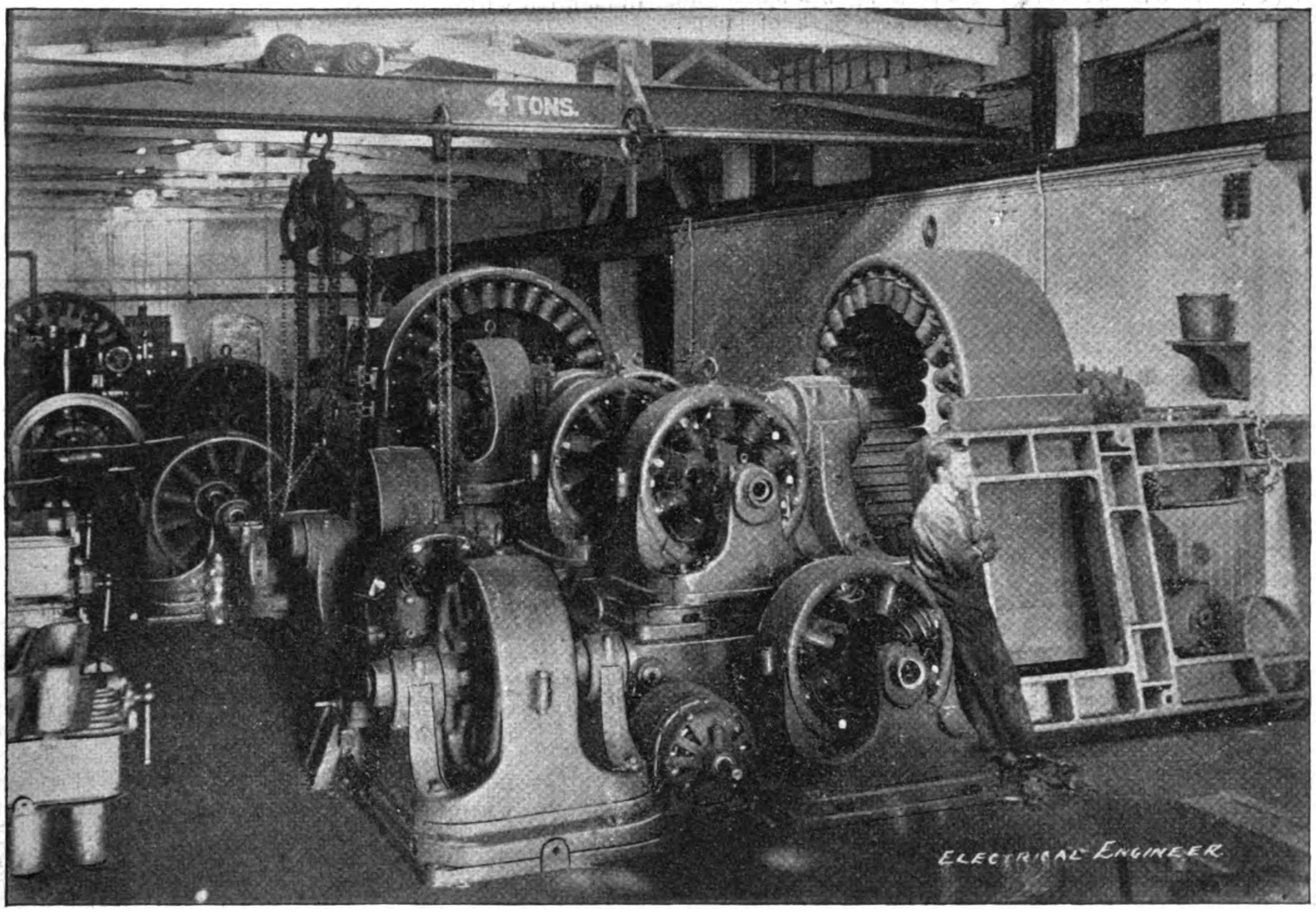
various factory departments are filled. In this storeroom we find rows upon rows of shelves and bins containing iron and brass screws, bolts, slate, marble and many tons of wire of all sizes stacked in great heaps; in addition the storeroom contains many of the finished parts which are kept in stock, such as brush-holders, armature ends, etc. Directly off from the storeroom is one of the numerous power and lighting plants which supply the various departments of the factory, this particular one being intended for the operation of the laboratory immediately overhead. This plant consists of two Westinghouse engines, one driving a continuous current machine and the other an alternator.

Passing beyond and ascending a few steps we reach the annealing department in which the sheet iron and steel employed in the construction of armature cores, converters, and the field magnet of the recently designed low frequency alternators are brought to the proper degree of softness. As much of the action of the machines depends upon the magnetic properties of the iron and steel employed, it is eminently necessary to bestow the greatest care on this part of the work, and for this purpose the sheets are packed into an annealing furnace and baked for from eight to ten hours at a uniform heat and then allowed to cool for six hours before removal from the ovens. Close besides these large annealing furnaces are others intended for the carbonizing of the lamp filaments. The filaments are packed into crucibles and baked in these furnaces heated by natural gas, and kept at an even temperature for many hours. They are then withdrawn to be further treated in the lamp department on an upper floor.

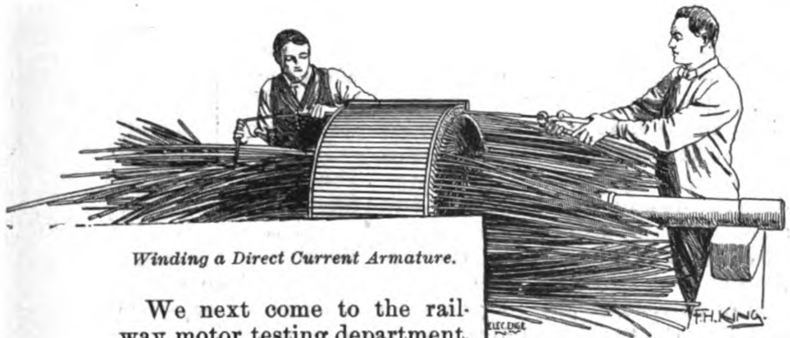
III.

A few steps further lead us to a most interesting display called the exhibition-room, in which a specimen of every apparatus and device manufactured by the Westinghouse Company is shown in practical operation. Here an attendant, by the turning of a switch, shows the manner in which the numerous mechanisms operate. The visitor learns by direct inspection the operation of the Shallenberger meter, and notes how its speed increases regularly with the addition of every lamp added to the circuit; at the same time the indicator and meter show the increased consumption of current, thus giving an optical demonstration of the fact that the true consumption is being recorded.

Another interesting part of the exhibition-room is the railway exhibit. In order to demonstrate, for example, the power and starting torque of the railway motor, the latter is connected with a dynamometer brake and scale, and by simply screwing up the brake the motor may be loaded to any desired capacity, while the visitor may compare the recording of the scale in pounds, and of the ammeter indicating the current. Added to this are several fully equipped trucks, double-reduction, single-reduction and gearless motors, together with platform switches. One of these trucks is also provided with an air brake operated by means of compressed air, supplied by a rotary air pump attached to the axle. A complete railway switchboard with automatic circuit-breakers completes this part of the exhibit. We might dwell at considerable length on the numerous devices which are shown in this interesting room, including the Tesla alternating motors, but must pass on to other departments of not less interest.



A View in the Erecting Shop—Westinghouse Electric Works, Pittsburgh.

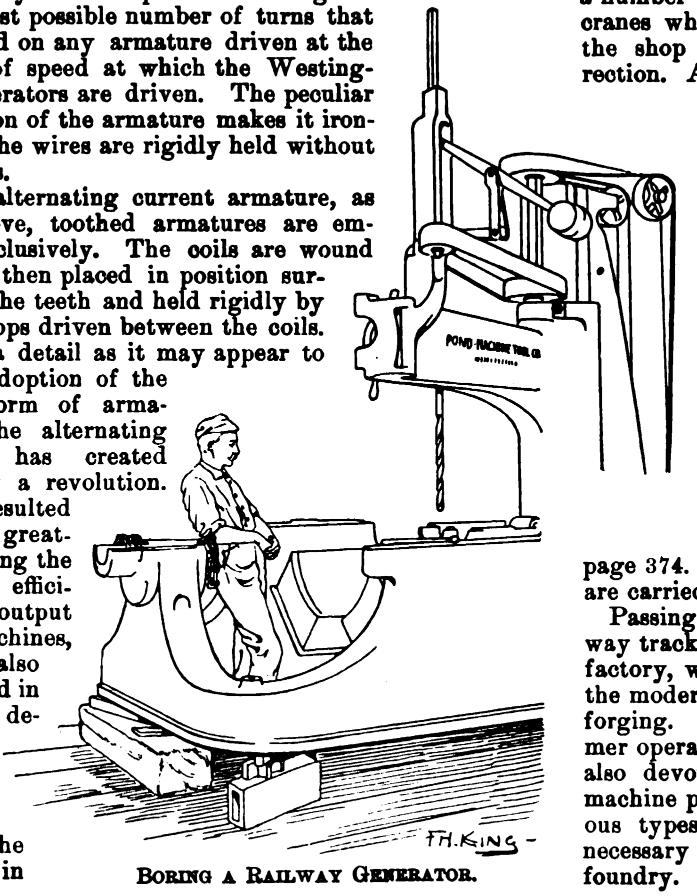


Winding a Direct Current Armature.

We next come to the railway motor testing department. Here all the machines before being shipped are given their final test, which determines not only their electrical but also their mechanical efficiency. For this purpose two machines are belted together; one operating as a motor and driving the other as a generator feeding a bank of lamps. Tests are now made at all speeds and loads; the conditions are then reversed, and the machine previously acting as a motor is driven as a dynamo by the other. Besides these mechanical tests, continuous tests for ground and other faults are carried out at a potential of 1,000 volts, that is, at twice the voltage normally supplied to the motors.

IV.

Just beyond the testing-room is the assembling department, where the fields and armatures are built up and fitted in their proper place. Our views on page 369 show a number of armatures in various stages of completion; and it will be noted that the toothed form of armature is now employed exclusively for alternating work; while for direct current the wires are placed below the external surface of the armature. A view on this page shows the operation of winding such a direct current armature. These armatures are wound with only two circuits, and all wires lying adjacent to each other are connected with adjacent bars of the commutator so that no high-tension wires touch each other at any place. There is only one turn per coil which gives the smallest possible number of turns that can be used on any armature driven at the low rate of speed at which the Westinghouse generators are driven. The peculiar construction of the armature makes it iron-clad, and the wires are rigidly held without band wires.



BORING A RAILWAY GENERATOR.

In the alternating current armature, as stated above, toothed armatures are employed exclusively. The coils are wound in a lathe, then placed in position surrounding the teeth and held rigidly by wooden stops driven between the coils. As small a detail as it may appear to be, the adoption of the toothed form of armature in the alternating machines has created practically a revolution. It has resulted not only in greatly increasing the electrical efficiency and output of the machines, but has also contributed in no small degree to their mechanical improvement. The wires held in position by the teeth are absolutely immovable, and a sudden overload does not, as formerly, lead to a straining of the wires. Besides, the ease of repairs made possible by the insertion of a new coil for a damaged one gives an additional value to this method of construction.

We have just remarked on the new departure seen in but a single detail of the machine, the armature, but we may observe the most interesting fact—and one demonstrating the thorough study to which the machines of the Westinghouse Company are constantly subjected—that hardly a single piece of apparatus now being built at these works is of exactly the same pattern as that built barely a year ago.

The railway motor assembling-room presents a busy scene, and an indication of the pressure of work in this department can be but vaguely conveyed by our illustration on page 370, which shows a pile of railway motor fields ready to be fitted with axle bearings.

V.

Finishing Slot in a Brush Holder.

The heavy machine tool shop, illustrated on page 374, occupies more than half the space of the square covered by the works. Our view on page 374 can give but an inadequate idea of the number and size of the machines here at work. Immense lathes, planers and boring mills finish the castings as they come from the foundry. And the handling of these heavy masses is very easily accomplished by a number of overhead cranes which traverse the shop in every direction. A large number of special tools are also at work, designed for the purpose of rapidly reducing the rough material to its finished shape, and thus effecting economy in time and cost of manufacture. Indeed, a notable feature of the equipment of the Westinghouse Works is the employment, wherever possible, of machines and devices for economizing time in manufacture, and also for the purpose of securing uniformity and interchangeability of parts. For this purpose, standard gauges are employed throughout the Works, so that when the parts are ready to assemble a touch of the file is scarcely required to fit them in their proper positions.

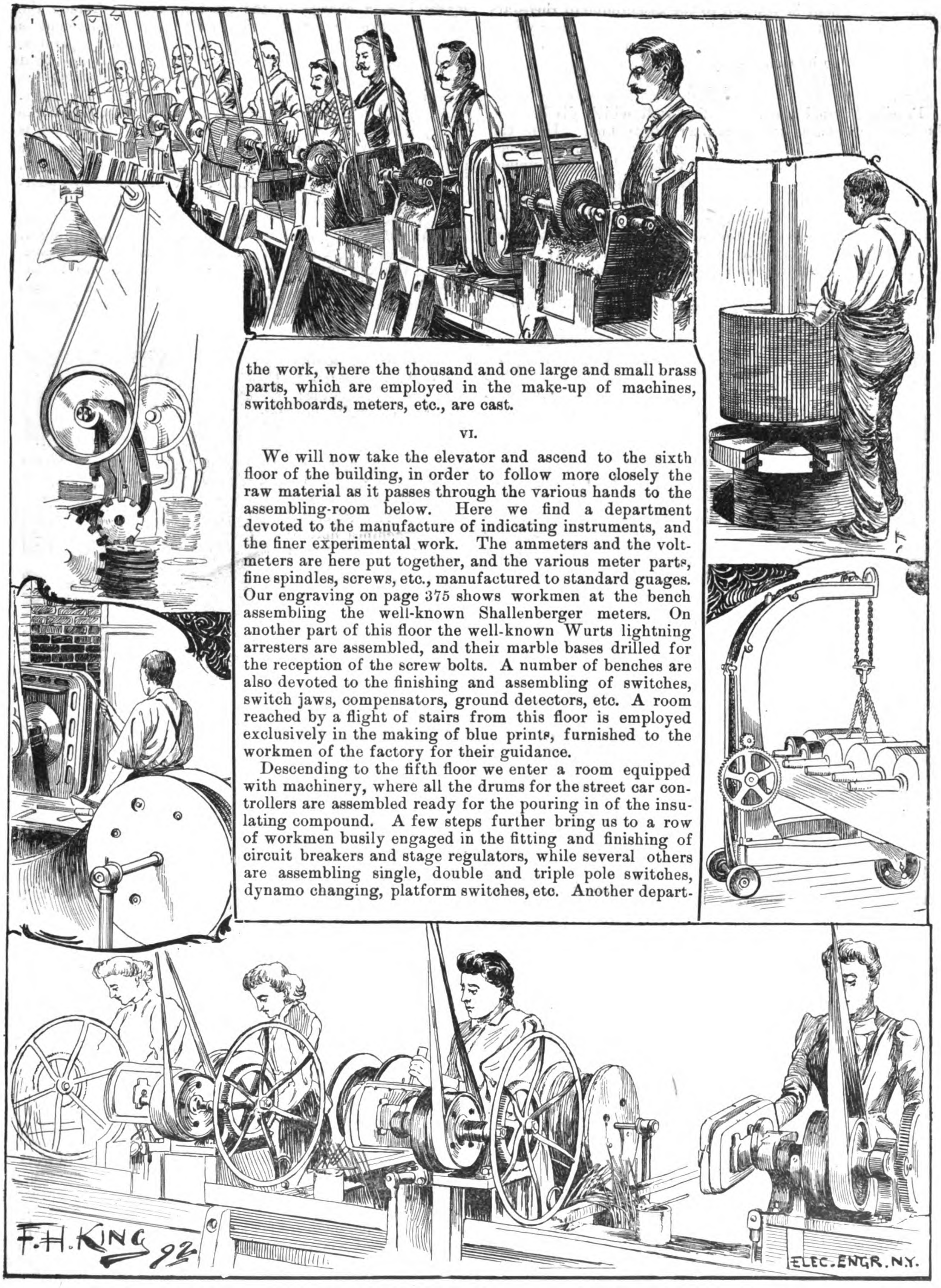
At the north end of this machine shop a line of heavy shafting drives the large alternating and continuous current generators undergoing test, a partial view of which is also shown on page 374. These tests, like those of the railway motors, are carried out with great care.

Passing out from the heavy machine shop across the railway tracks, by which the material is shipped from the factory, we find the blacksmith shop, equipped with all the modern tools, such as steam and drop hammers for rapid forging. Among the tools here employed is a drop hammer operated by an electric motor. Separate buildings are also devoted to the carpenter shop, where the various machine patterns and the woodwork required in the various types of apparatus manufactured, are finished. A necessary adjunct of every electrical shop is a brass foundry. A separate building is devoted to this part of the work, where the thousand and one large and small brass parts, which are employed in the make-up of machines, switchboards, meters, etc., are cast.

VI.

We will now take the elevator and ascend to the sixth floor of the building, in order to follow more closely the raw material as it passes through the various hands to the assembling-room below. Here we find a department devoted to the manufacture of indicating instruments, and the finer experimental work. The ammeters and the voltmeters are here put together, and the various meter parts, fine spindles, screws, etc., manufactured to standard guages. Our engraving on page 375 shows workmen at the bench assembling the well-known Shallenberger meters. On another part of this floor the well-known Wurts lightning arresters are assembled, and their marble bases drilled for the reception of the screw bolts. A number of benches are also devoted to the finishing and assembling of switches, switch jaws, compensators, ground detectors, etc. A room reached by a flight of stairs from this floor is employed exclusively in the making of blue prints, furnished to the workmen of the factory for their guidance.

Descending to the fifth floor we enter a room equipped with machinery, where all the drums for the street car controllers are assembled ready for the pouring in of the insulating compound. A few steps further bring us to a row of workmen busily engaged in the fitting and finishing of circuit breakers and stage regulators, while several others are assembling single, double and triple pole switches, dynamo changing, platform switches, etc. Another depart-



VIEWS IN THE WINDING, STAMPING AND ARMATURE CORE DEPARTMENTS.

ment on this floor is devoted to the assembling of rheostats of all sizes and forms. The German silver or heavy iron wire is supported on porcelain insulators fixed in iron frames, so as to be thoroughly fireproof.

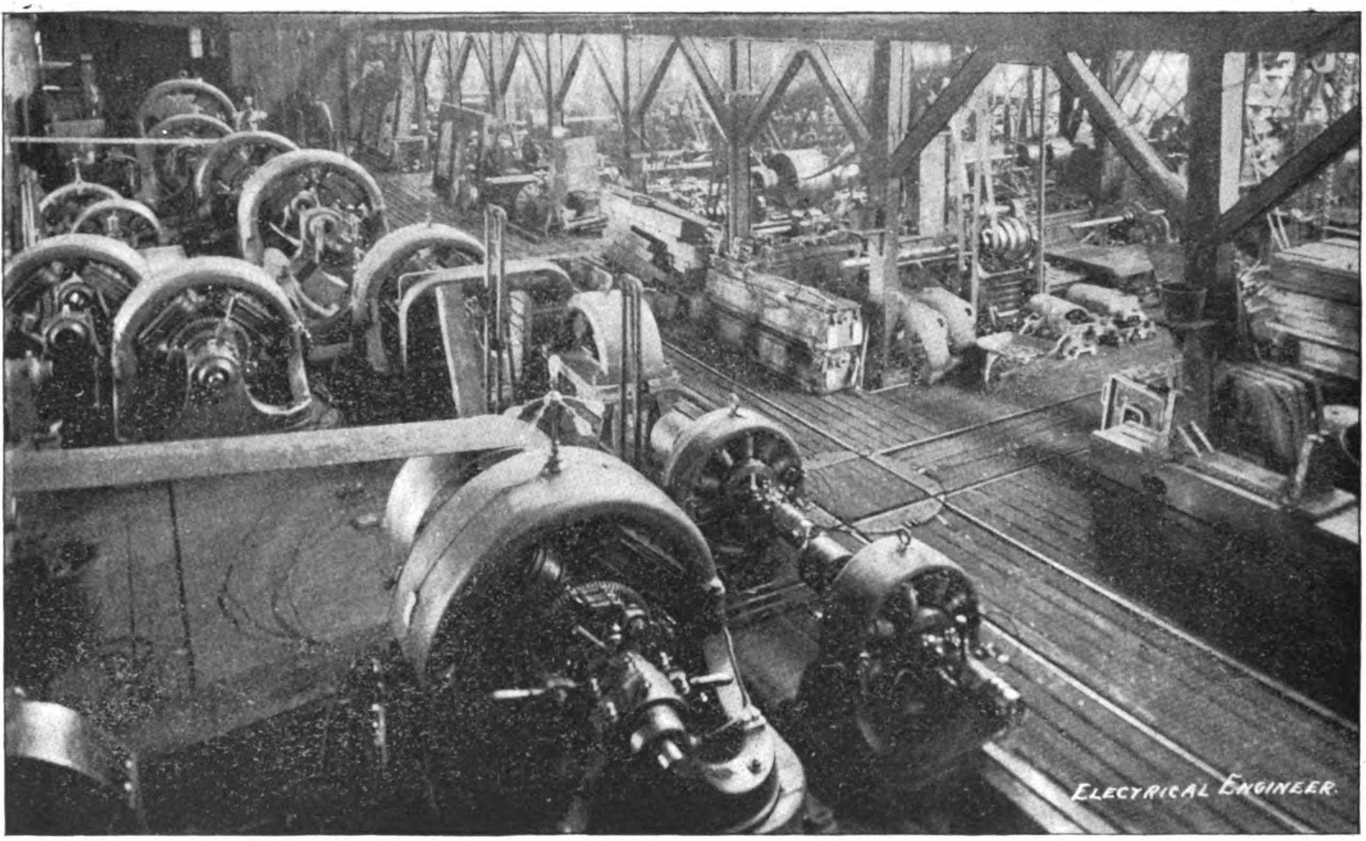
VII.

Passing beyond the heavy fire wall which divides the building, we enter the converter department. Here the stamped sheets of soft steel are built up around the converter coils and pressed into a solid mass. The employment of soft steel in place of iron has resulted in a great increase in the output, as well as in the efficiency of these converters. The method of building up these sheets without the interposition of paper or other auxiliary insulating material might at first thought give rise to unfavorable criticism, and, not very long ago, would have been considered little short of suicidal. But it was Mr. Albert Schmid, the superintendent of the Westinghouse Works, who discovered that the sheet material could be given a coating of oxide, which would thoroughly insulate plate from plate electrically, and thus obviate the necessity of interposing sheets of paper as had heretofore been done; and this method is now carried out in all the Westinghouse laminated work, not only in converters but also in armatures and laminated pole-pieces. At one side of the room a complete testing outfit is arranged for subjecting the converters to a thorough test before allowing them to go out. For this purpose each transformer is run for four hours at 20 per cent. beyond its rated capacity. On this floor also, the laminated pole-pieces intended for the new low-frequency Westinghouse alternator are built up, to be afterwards cast into a ring frame, forming a continuous magnetic yoke.

VIII.

We now enter the tool room, that important part of every large manufacturing establishment, where all cutters, punches, dies, jigs, etc., are finished to be delivered to the machinists in charge of the machine tools. Among the numerous excellent tools with which this department is equipped, may be noticed two oscillating emery planers. These machines, which are constantly at work, are built to handle large surfaces, such as are presented by the dies intended for punching out large armature plates. The object to be surfaced is fixed to a planer bed, and the emery wheel, besides its ordinary motion of revolution, is given a transverse motion at right angles to the bed of the planer; thus each part of the wheel is brought into action. This keeps it true automatically, and thus insures a thoroughly plane surface.

Retracing our steps and passing to the fourth floor below, we enter the department devoted to the assembling of armature cores. These are put together much in the same way as the converter cores, being placed one above the other in the shaft, and pressed into a solid mass. Then the ends are screwed on them and they are passed to workmen who file them down thoroughly and finish them ready for the reception of the winding.

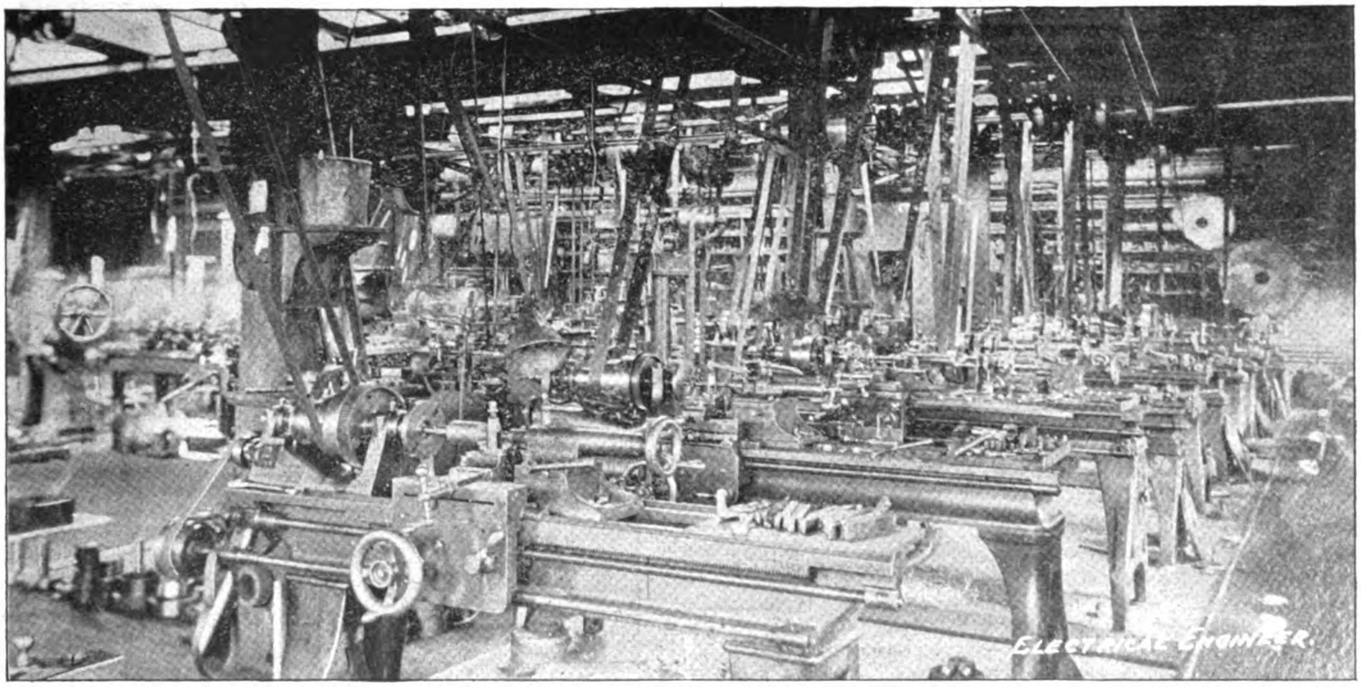


A CORNER OF THE HEAVY MACHINE SHOP AND DYNAMO TESTING DEPARTMENT.

The work in this department, as well as in others throughout the factory, is greatly facilitated by the employment of portable cranes. By means of these an armature core weighing several hundred pounds is lifted directly into a lathe and requires only a boy for its manipulation. One of these cranes is shown on page 373. An interesting process, and one illustrating the care which is bestowed upon the details of manufacture in the Westinghouse Works can be seen here. In finishing the slots of the brass brush holders much time would be required in filing, as machine work is practically impossible in this case. To save the time which would be thus occupied, steel cutting plugs are employed, which the workman drives through the slots by blows of a hammer. The operation is shown in our engraving, page 372, and the result is a perfectly smooth slot, exactly to gauge, and which requires not a touch of the file.

ELECTRICAL ENGINEER.

Assembling Shallenberger Meters.

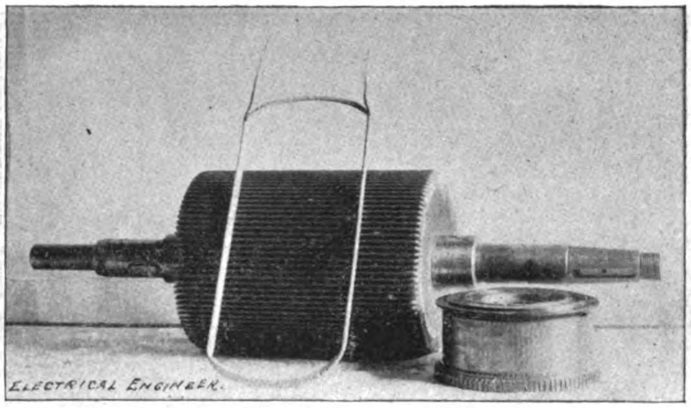


A Section of the Tool Room.

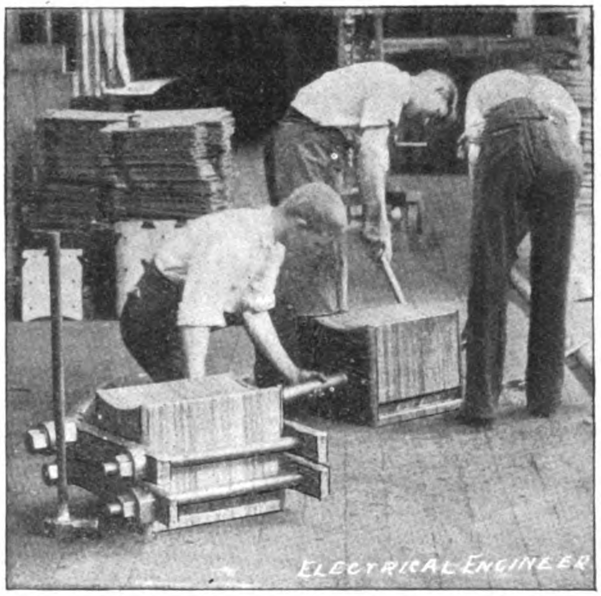
Passing through a partition, which keeps out all dust, we enter the rooms devoted to the testing of voltmeters, ammeters, station indicators, circuit breakers, as well as house meters. All these instruments are subjected to a thorough test and compared with standard instruments. Thus, the house meters are given a prolonged run, and their indications are continually checked by the reading of an electro-dynamometer. The durability and the careful construction of all the Westinghouse apparatus is strikingly illustrated in this meter. As has been already stated, there are now meters in operation measuring the current of nearly 1,000,000 16 c. p. incandescent lamps, and less than one per cent. of this total amount sold has ever been returned to the shop for any defect whatsoever.

IX.

Passing through the portals protected by heavy fire doors, we enter the armature winding department. Here the cores are first thoroughly covered with Fuller board and canvas soaked in insulating material and the coils then applied. One of our engravings shows a railway armature in three stages of progress of winding. The employment of specially wound coils for the railway armatures makes their winding very simple, and permits of easy replacement in case of damage, a process which involves some difficulties in the ordinary Siemens wound drum. Close beside are a number of benches devoted to the winding of the small solenoid coils of the Westinghouse arc lamps. When finished they are brought to the front of the building, which constitutes the assembling and test room for arc lamps, a view of which is given on page 377.



Railway Armature Core, Coil and Commutator.



Building up Laminated Pole-Pieces for Railway Generators.

On another part of this floor the car controllers are assembled. The interstices between the contacts are filled with insulating compound, giving the whole a perfectly cylindrical surface. Partitioned off from the rest of the work on this floor is the buffing shop where the many small parts are polished, ready to be lacquered.

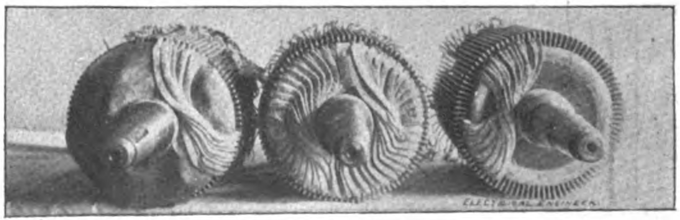
X.

The winding of the field magnet coils for the various types of generators and motors, as well as those intended for converters is done on the third floor. Our engraving, on page 373 hows clearly this operation which requires a considerable amount of skill and care. Each layer of wire is thoroughly insulated from its neighbor. The spools placed between lathe centres are driven by a belt from overhead, workmen guiding the wire into the proper channel as the spool revolves. During our visit this department was driven to its utmost capacity owing to the heavy demand for prompt delivery, especially of the electric railway apparatus, for which there is simply an enormous demand.

XI.

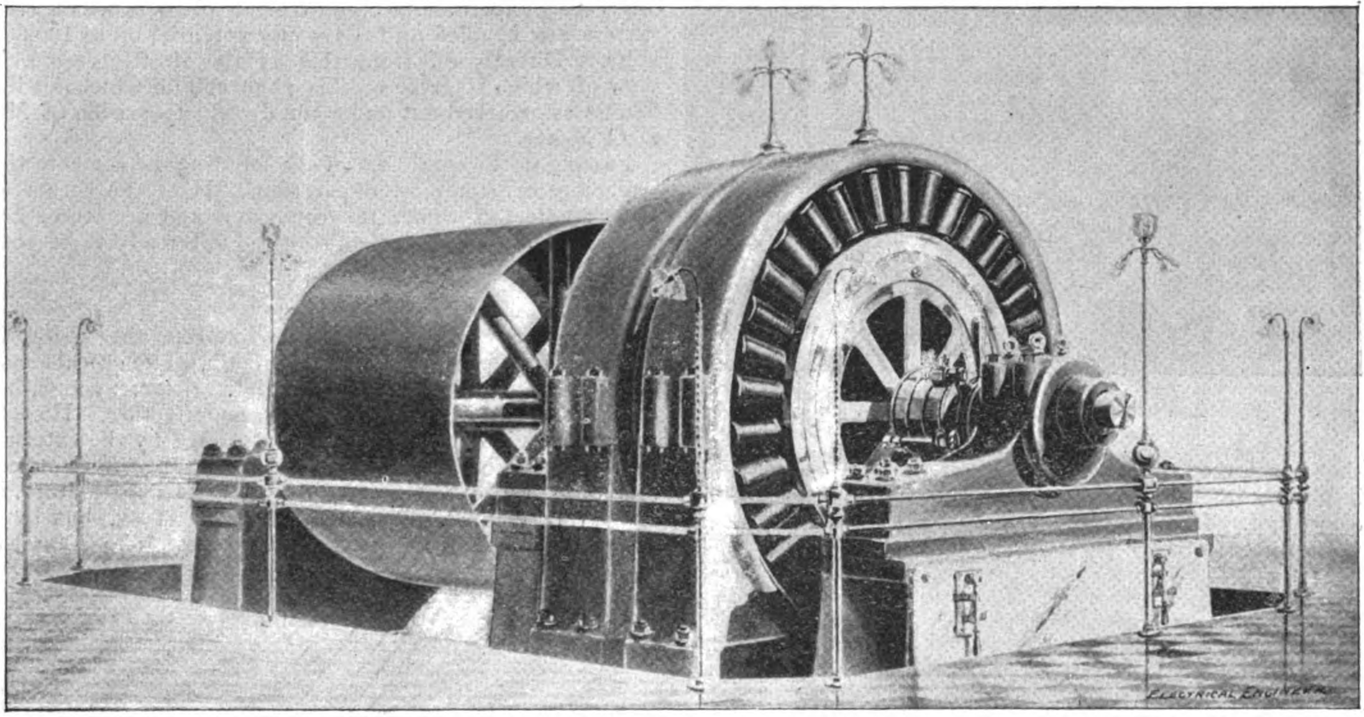
The filaments employed in the lamp manufacture are made in the Pittsburgh factory. As they come from the carbonizing furnaces, they are delivered to girls who place each filament in clips which are then covered by a glass globe from which the air is first exhausted by means of vacuum pumps. After the air is exhausted, hydrocarbon gas is admitted; the current being then turned on, the filament is brought to incandescence and the deposit of carbon from the hydrocarbon gas ensues. The flashing process gives the filament a uniform texture through its entire length, and when the proper resistance has been reached, the current is automatically cut off. Each girl operates two stands, one of these exhausting and the other flashing. In addition to the automatic arrangement for obtaining the correct resistance, each filament is additionally measured by means of a Wheatstone bridge.

Finishing an Alternating Current Collector.



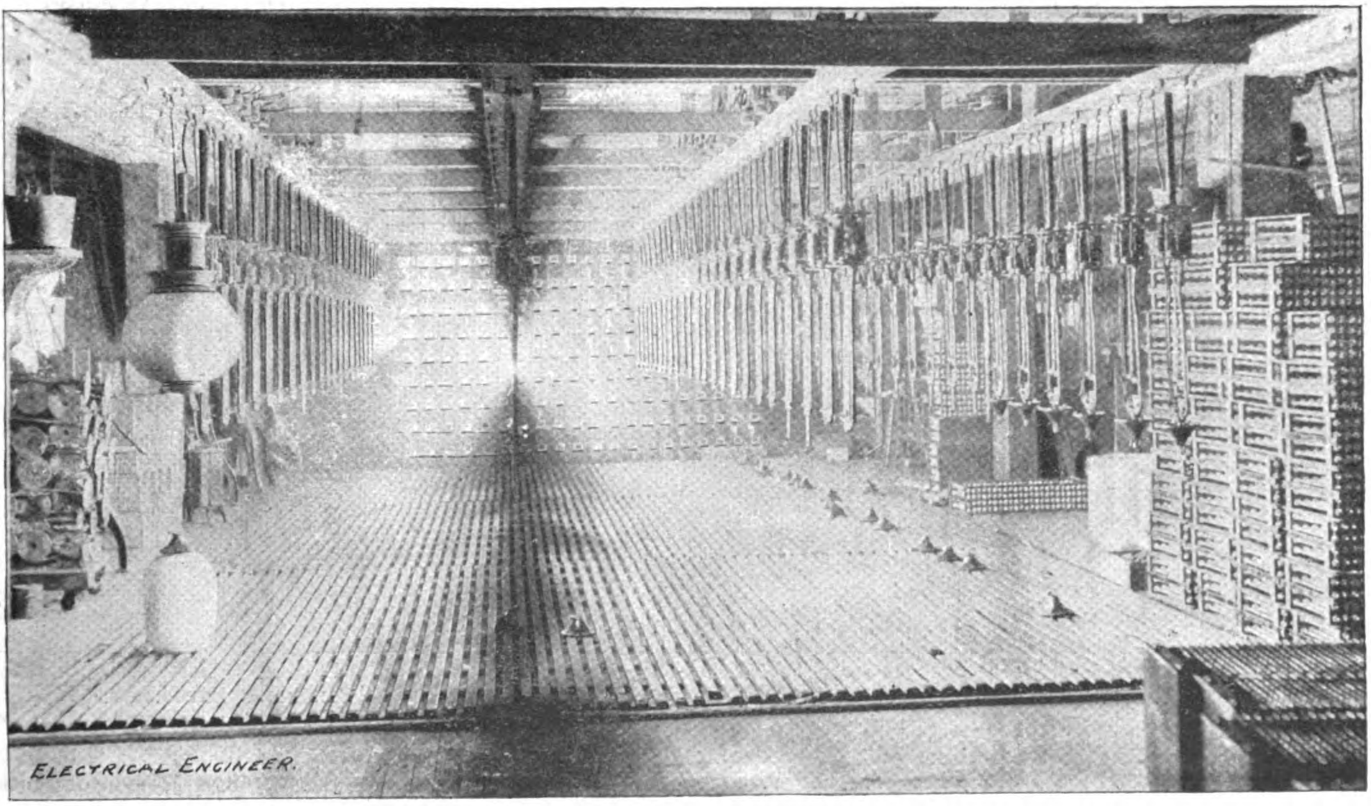
Railway Motor Armatures.

Adjoining the flashing department is the experimental shop where work is constantly going on to devise improvements in lamp manufacture.



10,000-Light Belt Driven Alternator for the World's Columbian Exposition.

The other side of the building on this floor is occupied by a series of gear cutters which operate automatically; the gear blanks, once inserted, require no attention until the gear teeth are finished. Here also, the gear cases which protect the gears from dust under the cars, and serve to deaden the noise of the gears, are fitted. The commutator and collector departments are also situated on this floor and offer a striking object lesson on the comparative simplicity and cheapness of construction of the latter as compared with the former.



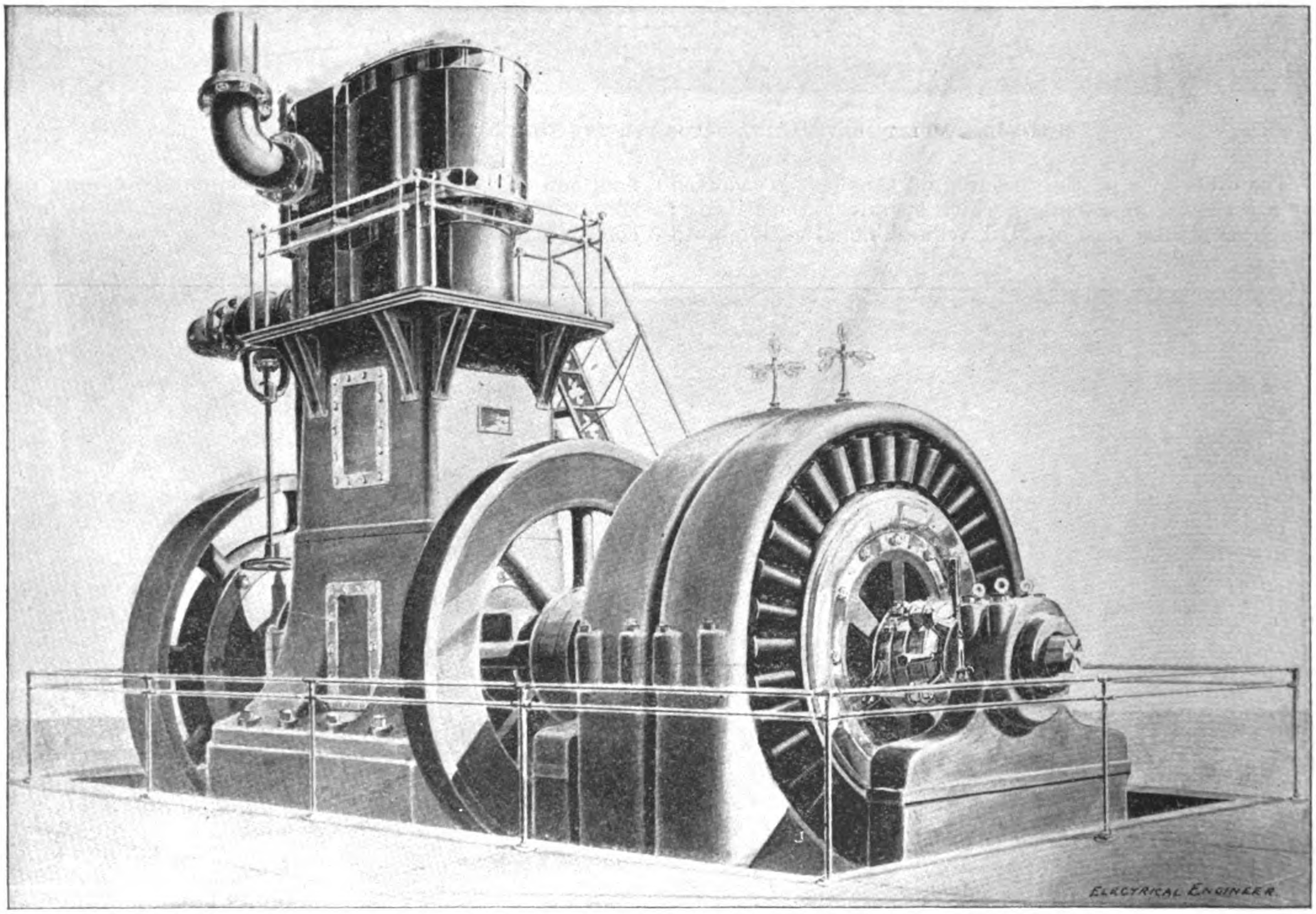
Testing Room for Alternating Arc Lamps.

XII.

Passing to the floor below, an army of girls may be seen

A VIEW IN THE DRAFTING ROOM.

taping and insulating the converter, field magnet and armature coils. The field magnet coils are first thoroughly shellacked, then covered with Fuller board, and wound with insulating tape and finally dipped in a special insulating compound. The primary and secondary coils of the converters are wound separately and then slipped over each other before insertion in the iron cores. This feature of separately winding the primary and secondary coils of the converters is controlled by patents of the company and by this means the greater durability and higher efficiency of the Westinghouse converters is largely assured. As we pass through the room we notice a long bench at which girls are sorting and cutting mica sheets which enter into the insulation of the commutator segments and a variety of other apparatus.



1,000 H. P. WESTINGHOUSE 2,000-VOLT QUARTER PHASE GENERATOR, FOR WORLD'S COLUMBIAN EXPOSITION.

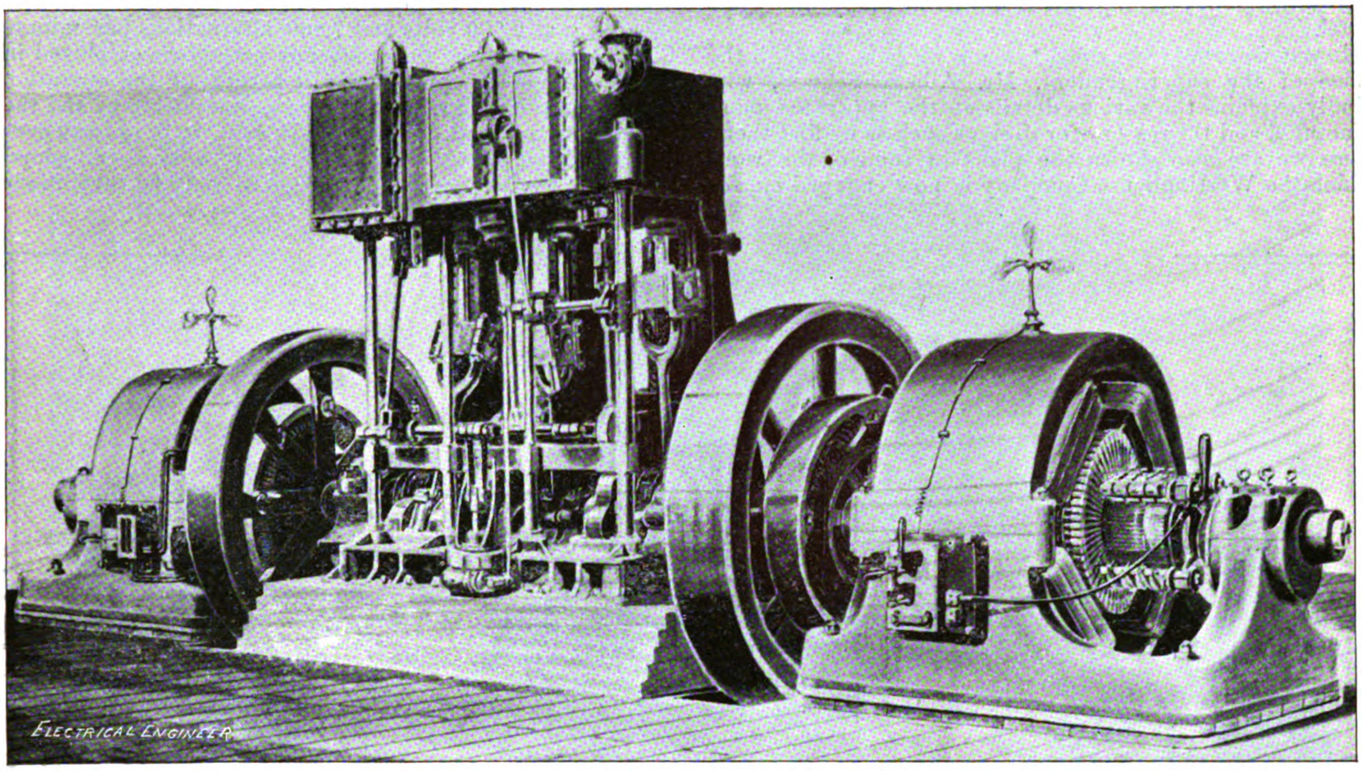
In the room adjoining this department we find a very interesting experimental high tension plant in which converters are coupled up to give any potential up to 100,000 volts. Directly off from this is the drafting-room, a view of which is given on this page and in which all the details are worked out under the direct supervision of Mr. E. C. Means.

Passing to the south end of the building we come to the punching or stamping department. Here the sheets of iron and steel of which the converters and armatures are made are first sheared, then stamped out ready to be sent to the assembling departments.

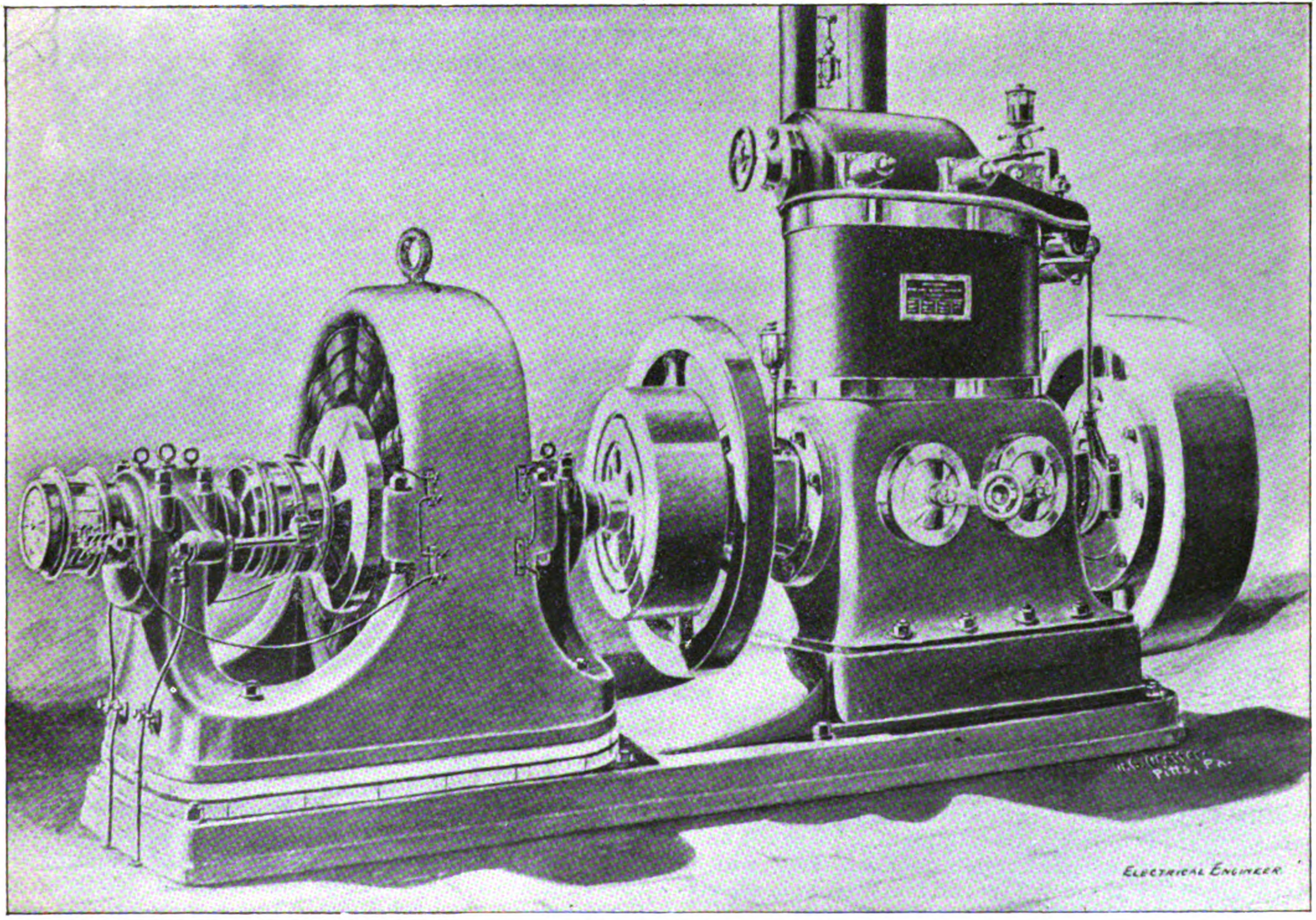
XIII.

In this hasty walk through the building the visitor is everywhere impressed with the thorough, systematical handling of all apparatus and material, without which, of course, there can be no economy in manufacture. His attention in this connection is also attracted by the extreme cleanliness observed. Dust, the great enemy of electrical apparatus, especially in the course of its manufacture, is effectively combatted, not by the usual brush, but by a complete system of compressed air piping. This is tapped at innumerable points and by flexible tubing, is brought by the workman to the necessary points. The strong blast blows all dust out of holes and cavities which to a brush would be inaccessible.

The welfare of the workmen is also thoroughly considered and the neat porcelain enameled wash-basins and polished faucets in every department will stand compari-



Two 250 H. P. Westinghouse Multipolar Railway Generators Direct Connected to Globe Iron Works Triple Expansion Engine.



Westinghouse Alternator Direct Connected to Westinghouse Engine.

son with similar arrangements in almost any first-class hotel.

In our passage from shop to shop we pass through the office of the superintendent, Mr. Albert Schmid, who kindly explains the various details of the apparatus manufactured and the reasons for designs such as we find them. Here we are also shown the plans of some of the work which the Westinghouse Company is now engaged on, for supplying the World's Columbian Exposition, at Chicago, with light and power. The power plant which will be there shown will be a striking example of large power units in various types of generators; four of these will be driven direct by the new type of the Westinghouse vertical compound engine. The armatures of these machines will be of the toothed type, with removable coils and composite wound for constant potential. Besides this there will be six machines, belt driven, one of which will be a thousand horse power, quarter phase, alternating generator operating at 2,000 volts and 7,200 alternations per minute This departure from the frequency heretofore employed in the Westinghouse apparatus will permit of the operation on the same circuit of arc and incandescent lamps and the Tesla motors as well. Besides this, a 500 h. p. railway generator will be shown coupled direct to a cross-compound Reynolds-Corliss engine operating at only 90 revolutions per minute. Our engravings on pages 377, 378, 379 and 382, will give a good idea of the magnitude of this work.

Philip Lange.

Albert Schmid.

O B. Shallenberger.

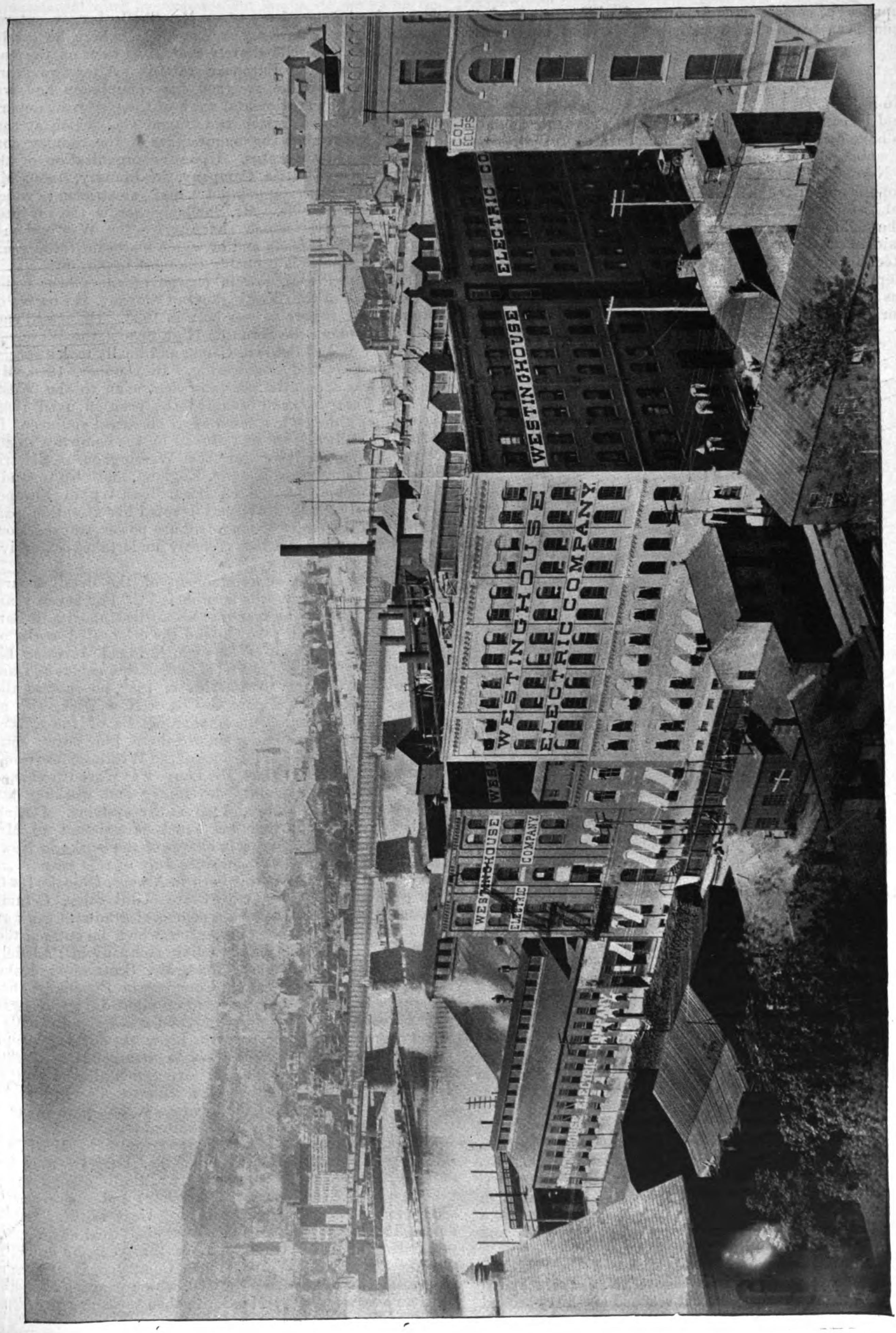
TECHNICAL STAFF;
WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY,
PITTSBURGH, PA.

C. F. Scott.

L. B. Stillwell.

F. S. Smith.

The laboratory of the works, now under the direct charge of Mr. Charles F. Scott, is situated immediately above the main offices. Here the electrical details of all the apparatus are worked out. The laboratory also constitutes the standardizing bureau for all electrical shop instruments of every description and various investigations are constantly going on. The equipment of the laboratory



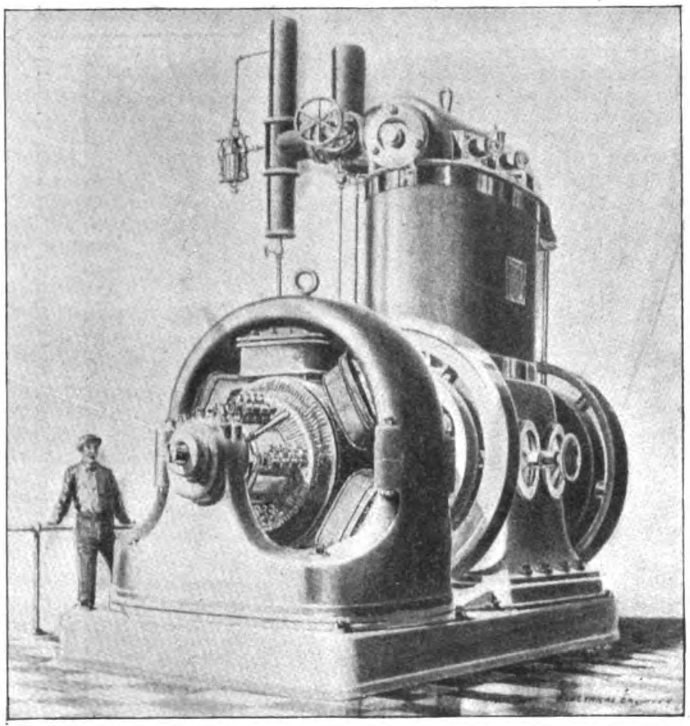
General View of the Westinghouse Electric Company's Works; Pittsburgh, Pa.

comprises a complete equipment of the most modern standard apparatus of both continuous and alternating type.

XIV.

No account of the work of the Westinghouse Company would be complete without a few words regarding the men who have contributed to bring the apparatus to the perfection which it now exhibits. We have already alluded to Mr. Nikola Tesla, whose recent enthusiastic reception in Europe is one of the most striking episodes in modern electrical history.

The technical staff of the Westinghouse Company may be said to offer a striking example of the value and demand for technical training, for without exception the heads of all departments are men who are graduates of colleges. This forms a striking contrast to conditions presented in manufacturing establishments of many older industries in which they who are frequently misnamed "practical men," or those who have graduated from the machine shops, rule the destinies of manufacturing works.



500 H. P. Railway Geneator Direct Connected to Westinghouse Engine.

The mechanical superintendent of the works, Mr. Albert Schmid, was born at Zurich, Switzerland, in 1858, and graduated from the celebrated Polytechnic in that city. In his early career he obtained considerable experience in the manufacture of steam engines, locomotives, turbines and electrical apparatus, widening his experience by sojourns in England, France, Belgium, Switzerland and Germany. In 1882, Mr. Westinghouse induced Mr. Schmid to come to Pittsburgh, where he entered the employ of the celebrated Westinghouse Air Brake Co. Upon the organization, shortly after, of the Westinghouse Electric Co., Mr. Schmid was placed in charge of the manufacturing department which position he has held ever since. In conjunction with Mr. Westinghouse, Mr. Schmid justly shares not a little of the credit for the admirable construction and design of the Westinghouse apparatus.

Mr. O. B. Shallenberger, the electrician of the Westinghouse Company, was born in Rochester, New York, and is still a young man, having now but reached his thirty-second year. At the age of seventeen Mr. Shallenberger entered the U. S. Naval Academy at Annapolis, where he graduated in 1881, and immediately thereafter went on the customary cruise to the European stations. After two years' service, however, he resigned his commission and was engaged in the experimental work of the electrical department of the Union Switch and Signal Co., which at that time had undertaken the manufacture of the Stanley continuous current apparatus. Upon the organization of the Westinghouse Electric Company, in January, 1886, Mr. Shallenberger was appointed chief electrician; which position he still holds. Mr. Shallenberger is the inventor of many features which characterize the Westinghouse apparatus as now made and of which his beautiful alternating current meter is probably the most important.

Mr. L. B. Stillwell, now in charge of the power transmission work of the Westinghouse Company, is a native of Scranton, Pa., where he was born in 1863. He passed successively through the Scranton High School, the Wesleyan University at Middletown, Conn., and finally took a special course in electrical engineering. In October, 1886, Mr. Stillwell was appointed assistant electrician to the Westinghouse Company, and occupied the position until 1889, since which time he has acted as its electrical engineer. In 1890, Mr. Stillwell was sent abroad by the company to act as consulting engineer for the Westinghouse Electric Company, Limited, in London, England, and also to study the development of the electrical industry in Europe. More recently Mr. Stillwell has devoted his attention particularly to the study of long-distance power transmission, for which purpose he has recently undertaken extensive trips South and West.

Mr. Philip Lange, superintendent of the detail department of the company, was born in 1856. For seven years he was engaged in the manufacture of instruments in Berlin, Germany, and in 1880 entered the celebrated works of Siemens Bros. & Co., of Woolwich, England, devoting his attention to the manufacture of submarine cables and arc lamp work. Coming to America in 1882, he entered the service of Messrs. Bergmann & Co., of New York, who at that time manufactured the smaller details of the Edison system of lighting. He remained there four years, until 1886, when he entered the service of the Westinghouse Company at Pittsburgh. Here Mr. Lange was placed in charge of the "detail department," developing and working out the details of alternating and street car systems. During the last year Mr. Lange has acted as assistant to Mr. Schmid, and as such is now in charge of the works in Newark, N. J., where he has been since July of this year.

Mr. Charles F. Scott was born in Athens, Ohio, in 1864, and graduated at the Ohio State University, Columbus, in 1885. He then took a course of graduate work at the Johns Hopkins University, after which he entered the electrical field with a constructing company in Philadelphia in 1887. In August, 1888, Mr. Scott entered the employ of the Westinghouse Company in Pittsburgh, beginning work in the dynamo room on night duty. He was soon transferred to the laboratory, and was assistant to Mr. Tesla during the latter part of his work on alternating motors at Pittsburgh. After the departure of Mr. Tesla, Mr. Scott was placed in charge of experimental work on the Tesla motor. Mr. Scott has been assistant electrician for the last year in charge of the laboratory, and part of the time during the absence of Mr. Shallenberger.

The superintendent of the lamp department, Mr. F. S. Smith, was born in 1863, at Kingston, Pa. In 1882 he entered the Wesleyan University at Middletown, Conn., taking a two years' course of chemistry and the natural sciences; he then proceeded to Lehigh University at Bethlehem, Pa., where he took a course in analytical chemistry, graduating in 1887. On June 1, of that year, he entered the service of the Westinghouse Company as assistant superintendent of the lamp factory, which position he held for a number of years. Mr. Smith then took charge of the experimental work in incandescent lamps, to which he devoted a year, and since then he has been superintendent of the lamp department, in addition to that of the experimental work.

Mention must also be made here of Messrs. B. G. Lamme, E. C. Means and H. P. Davis, who have been connected with the Westinghouse Company for a number of years, and who have ably assisted Mr. Schmid in the designing of the Westinghouse apparatus.

XV.

In the above we have limited ourselves to the description of but one of the manufacturing establishments of the Westinghouse Co. But some detailed mention must also be made of the factory in Newark, N. J. These works, which are in charge of Mr. Philip Lange, cover nearly an entire block, and are five stories high. It is here that the large direct current dynamos for isolated lighting, electrolytic work, etc., are manufactured, and, also, motors of all sizes.

In the foregoing the writer has endeavored to give, as nearly as possible, an accurate description of the most important departments of the works of the Westinghouse Electric and Manufacturing Company in Pittsburgh. It is not meant to be a complete description of everything he saw there, indeed such a task, while it would be a pleasant one, would make this issue of the ENGINEER much too bulky. It is safe to say that there is no other electric company in the world, the product of which affords more of interest to the electrical industry and the public in general, than does that of the Westinghouse Company.

Rarely, indeed, is there a manufacturing company, either in the electrical or any other industry, which in the short space of time, of less than a decade, can produce a record of achievements equal to that of the Westinghouse Company. Their product has in that time been sold in every corner of the globe. Their apparatus is operating in gold mines in Colorado, in coal mines in Pennsylvania; it generates electric current for lighting one of the largest parts of the city of London, England, as well as towns in China, Japan and Australia. Its apparatus for the operation of electric railways has within two years revolutionized the entire manufacture of electric motor systems. There is, in fact, not a branch or a field in the electrical industry that is not occupied by this enterprising corporation.

LETTERS TO THE EDITOR.

TWISTING MAGNETISM AND UNIPOLAR MACHINES.

As one who is deeply interested in any line of experimental work that may lead to new results, I read with interest the article entitled "Twisting Magnetism" which appeared in your issue of Sept. 7, in which Mr. Balch describes the ingenious manner in which he has sought to "coil" the moving conductor and thus produce a machine capable of generating a higher potential than has been common to this class of dynamos in the past. Although these experiments have been without result so far, owing seemingly to his inability to "twist" magnetism, still they are productive of great good in pointing out to the investigator in this field, a new and possible way in which the desired result can be obtained, providing, of course, that the present apparently insurmountable difficulties may be overcome.

I was therefore greatly surprised to read in your issue of Sept. 21 a communication from Mr. J. C. Reusch condemning the machine of Mr. Balch by a rule set forth by Silvanus P. Thompson in his work on "Dynamo-Electric Machinery," to cover an entirely different class of machines, *i. e.*, the ordinary bipolar or multipolar dynamo in which the current is produced in the conductor by "altering the number of lines of force that flow through it." If I understand the matter correctly, this rule was never meant to apply to unipolar machines, one of which, the dynamo of Prof. Forbes is illustrated and described in the above-mentioned work. In this machine, the conductor moves between two magnetic forces of opposite polarity so that there is a continuous cutting of the lines of force by the conductor, but no alteration in the number of such lines passing through the "circuit of which the moving conductor forms a part." In this machine the field is perfectly uniform and "the conductor is moved by a motion of translation to another part of the uniform field" and does produce a current, notwithstanding Mr. Reusch's sweeping quotation to the contrary.

It seems to me that it is unfair to Prof. Thompson to quote his words in respect to one class of dynamos in condemning a modification of another distinct class, and that Mr. Reusch has not given the subject the attention it deserves when he so quotes him. Even had so eminent an authority as Prof. Thompson laid down this law to cover this class of unipolar machines, it does not appear that it should be set up as a barrier in the way of the experimenter, who, in the range of possibility may find instances in which this law should be qualified.

I have written as above because I feel that an injustice has been done Mr. Balch in thus supposing him to be unacquainted with a rule that is generally supposed to be the A B C of practical dynamo construction and not because I am able to suggest an explanation of the reason his machine does not yield a current, other than by saying that in this machine at least, magnetism *does not twist*, this being the only essential difference between it and the dynamo of Prof. Forbes in which twisting magnetism is not required. Whether magnetism can be made to twist, or not, is good subject-matter for experimental work and the individual who can first say why it does or will not twist is the one who can justly point out to Mr. Balch the error of his ways.

W. E. HYER.

NEWBURGH, N. Y., Sept. 26, 1892.

UNIPOLAR DYNAMOS—A SUGGESTION.

To endeavor to extricate a fellow-being who has fallen into one of "the many traps by which the venturesome inventor is ensnared in Dame Nature's unexplored domain," should be a more laudable desire than to simply point out to him the danger after his fall!

Mr. Reusch has courteously indicated to Mr. S. W. Balch why his dynamo-electric machine, described in an article entitled "Twisting Magnetism," was unable to furnish current;—allow me to suggest how that machine may be transformed into a current producer.

I believe I am right in stating that all magneto-electric induction currents consist of a succession of wave motions, and in graphically describing them we invariably draw a curve. The alternating current, if analyzed, no matter how rapid the alternations may be, is a succession of waves. The so-called continuous current also consists of waves, even if we carry out our system of commutation to the last degree. This is unavoidable, for, to obtain any current at all, the lines of force cut through by an inductor traveling in a magnetic field, must be more numerous in some parts than in other parts of that field. In other words the intensity of the magnetic field must not be the same in its every part, but must be so formed as to allow the inductor to move through force of varying intensity.

This is fundamental, but unfortunately it renders impossible the designing of a machine to generate a perfectly constant or uniform current in one direction.

Referring to unipolar dynamos, we may well study Mr. Tesla's design in the specification of his U. S. patent No. 447,921, issued March 10, 1891, which discloses a unipolar machine having a magnet core identical to the one shown by Mr. Balch, with one exception, which however renders the Tesla machine operative.

In Mr. Balch's machine the surface of the annular or disk-like poles is flat, thereby presenting a field of perfectly uniform strength to the inductor at all points in its travel; while the Tesla annular poles are corrugated or serrated or grooved radially, by means of which, the field is divided into a large number of radially defined portions, contiguous ones being alternately of lesser and greater intensity. If paraphrasing is allowed, we may say that the moving inductor passing through these portions will so cut the magnetic lines as to alter by its motion the number of lines that pass through said inductor.

Now, if Mr. Balch will make serrations or grooves in the surfaces of his poles in a direction similar to the length of his inductor, he will undoubtedly generate currents therein.

I may however hold up before him the horrible fate he would encounter should he attempt to "make, use or sell" his machine modified as above, as it would appear to infringe the aforementioned patent to Mr. Tesla, the first claim of which, recites:—"The combination, in an annular field of force formed by opposing polar faces with radial grooves or serrations, and with said poles, of a connected series of radial conductors, so disposed with relation to the serrations that while one portion of the radial conductors is passing between the strongest parts of the field, on the points where the two poles most nearly approach, the adjacent or intermediate conductors will pass through the weakest parts of the field, or the points where the two poles are most remote, as set forth."

This claim is an exceedingly broad one, and such claims are not always found to be tenable by the courts, which after all are the most practical appraisers of the work of the inventor.

HENRY GUSTAVE ROGERS.

CLINTON, Conn., September 30, 1892.

SOCIETY AND CLUB NOTES.

THE NEW YORK ELECTRICAL SOCIETY.

WE have received the following announcement from Mr. Geo. H. Guy, secretary of the New York Electrical Society, Room 812, 203 Broadway, N. Y.

Following its usual custom the society proposes this year to continue its course of lectures, which will comprise fifteen in all, embracing the following subjects, and with the names of the lecturers, where their services thus far have been provided for:

1. The Arc Light (with experiments). By Mr. R. S. Dobbie. 2. The Telephone, (experimental). By Mr. J. J. Carty, electrician Metropolitan Telephone Co., New York City; and Mr. F. A. Pickernell, engineer American Tel. & Tel. Co. (Long Distance Co.) 3. How to Lay Out and Wire an Isolated Lighting Plant, and How to Operate It. By Mr. Aug. Noll, superintendent New York Electric Equipment Company. 4. Primary Batteries, (with exhibit of various batteries). By Mr. G. d'Infreville, late electrician Western Union Tel. Co. 5. Electricity in Medicine, (experimental). By Dr. William J. Morton. 6. The Progress of the Year. By Mr. Joseph Wetzler. 7. What Europe is Doing in Electricity. By Prof. F. B. Crocker. 8. The Magnetic Field. By Prof. E. J. Houston. 9. Insulation and Surface Leakage, (with experiments). By Dr. J. B. Williams. 10. Electric Heating, (with experiments.) 11. The Storage Battery. 12. The Continuous Current Motor, (with experiments.) 13. The Alternating Current Motor, (with exhibit.) 14. Electric Railways. 15. The Incandescent Light.

In order to attain the full measure of its usefulness, and to encourage beginners to associate themselves with it, the society makes no distinction whatever in the grade of its membership, to which any person interested in its work is eligible without examination of any kind as to his knowledge of the subject. An invitation is extended to all amateurs, students, artisans, manufactures and others interested in the progress of electricity to join the society and aid it in its work.

The dates and meeting place for the lectures will be announced in due season. Admission, which is free, can only be gained by non-transferable tickets which can be had on application to the secretary. The annual dues to the society are $3 00, and the secretary will furnish blank forms of application for membership on request.

THE 146th meeting of the Society will take place at Columbia Hall on Wednesday, Oct. 19.

PROF. F. B. CROCKER will deliver an address entitled "What Europe is Doing in Electricity," in which he will describe the numerous electrical establishments visited by him during a recent trip abroad.

PROF. CROCKER will point out specially the differences between our methods and those in vogue abroad, illustrating his remarks by photographs which will be exhibited.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED OCTOBER 3, 1892.

Accumulators :—

Storage Battery, E. R. Knowles, Brooklyn, N. Y., 483,562. Filed Oct. 15, 1891.

The element consists of separated elementary cells perforated and filled with absorptive material, and spacing strips separating the cells; the whole being confined by bands and rivets.

Storage Battery, E. R. Knowles, Brooklyn, N. Y., 483,563. Filed Oct. 15, 1891.

Employs an electrode consisting of trays arranged one on top of another and connected by a strip.

Alarms and Signals :—

Electric Burglar Alarm, H. T. Wilson, Louisville, Ky., 483,625. Filed June 9, 1892.

Electric Burglar Alarm, A. Stromberg, Chicago, Ill., 483,728. Filed Mar. 15, 1892.

Burglar Alarm Contact, N. M. Hopkins, Washington, D. C., 483,844. Filed May 9, 1892.

Conductors, Conduits, and Insulators :—

Process of Making Artificial Mica Sheets for Electrical Insulation, A. H. S. Dyer, Schenectady, N. Y., 483,646. Filed June 1, 1892.

An arrangement by which artificial plates are formed of small broken scales of mica.

Molding Mica Forms for Electrical Insulators, C. W. Jefferson, 483,653, Schenectady, N. Y., Filed June 1, 1892.

Closed Conduit for Electric Railways, W. G. Creighton, Norwood Park, Ill., 483,761. Filed Feb. 6, 1892.

A combined tube and rail having an angular slot for the passage of the traveling contact.

Insulator, A. P. Seymour, Syracuse, N. Y., 483,771, Filed March 5, 1892.

Consists of a solid block of porcelain provided on its periphery at one end with two lugs on opposite sides of the line in which the wire lies when passed beneath both the lugs.

Dynamos and Motors:—

Motor Mounting for Electrically Driven Fans, A. L. Riker, New York, 483,582. Filed Dec. 22, 1891.

Consists in an arrangement such that the shaft and magnet frame are each removable without disturbing the other.

Armature for Dynamos and Motors, E. Thomson, Swampscott, Mass., 483 700. Filed Dec. 2, 1891.

Employs a core having one or more notches and filling plugs and having projections on its inner surface, and separable coils of such size and shape as to be cast through the notches and over the projections between which they are held in place.

Armature for Motors and Generators N. C. Bassett, Lynn, Mass., 483,708. Filed Feb. 27, 1891.

Employs an interior core, to which are attached surface sections extending out over the coils and meeting at the surface so as to complete the enclosed coils.

Armature Winding for Dynamo-Electric Machines, E. P. Warner, 483,729. Filed Sept. 30, 1889.

Employs coils symmetrically placed upon the armature with only two joints in the entire system of winding; the different coils being extended at one end to facilitate the connection with the commutator segments.

Commutator for Electric Machines, N. C. Bassett, Lynn, Mass., 483,732. Filed Aug. 26, 1891.

Employs a shell with the commutator segments arranged above the periphery and a number of individually adjustable clamping devices, each engaging with two or more segments.

Alternating Current Motor, W. Stanley, Jr., and J. F. Kelly, Pittsfield, Mass., 483,816. Filed Mar. 10, 1892.

Employs a condenser in shunt, with the motor of a capacity capable of neutralizing the self-induction of the motor.

Electric Locomotive, T. L. Willson, Brooklyn, N. Y., 483,822. Filed Aug. 25, 1891.

The combination of an armature shaft geared to the driving wheel, an armature loosely mounted on said shaft and having a recessed hub, and a friction clutch engaging between the shaft and the hub.

Galvanic and Thermo-Electric Batteries :—

Galvanic Battery, H. T. Johnson, New York. 483,651. Filed Dec. 10, 1891.

Has the exciting agent and the depolarizing agent arranged ultimately in horizontally disposed strata within the cup shaped positive electrode.

Thermo-Electric Battery, P. Giraud, Chantilly, France, 483,782. Filed Aug. 1, 1891.

Employs an electrode composed of antimony, zinc, cadmium and silicium.

Heating:—

Electrical Heater, A. E. Appleyard, Boston, Mass., 483,758. Filed Sept. 14, 1891.

Employs a resistance of carbon having wires connected to its ends and an externally exposed homogeneous waterproof insulating covering enclosing the sides and ends thereof.

Electrical Heater, A. E. Appleyard, Boston, Mass., 483,759. Filed Dec. 28, 1891.

Employs a water-tight casing enclosed in which is a resistance consisting of a strip of ribbon form, the sides being presented to the walls of the casing.

Electric Heater, F. B. Perkins and C. S. Jones, Toledo, O , 483,940. Filed April 1, 1892.

Employs an insulating cylinder fitting over the bottom aperature in the heating place and a conducting wire walled longitudinally upon the cylinder extending over its inner and upper faces.

Lamps and Appurtenances :

Adjustable Electric Light Hanger, H. L. Holt, Ellsworth, Me., 483,556. Filed Feb. 5, 1892.

Holder for Incandescent Lamps, E. P. Allam, Romford, Eng., 483,974. Filed Oct. 27, 1891.

Miscellaneous:—

Fire Extinguisher, Oscar J. Averell, New York, 483,522. Filed March 11, 1890.

A chemical fire extinguisher operated by electric current.

Electric Fan, E. B. Cutten, New York, 483,545. Filed May 22, 1891.

Comprises a base containing the motor, a vertical shaft projecting upward, a fan carried by the shaft and a connecting socket mounted at the top of the shaft.

Electromagnetic Mechanism for Operating Printing Presses, E. H. Korsmeyer, Kansas City, Mo., 483,564. Filed Sept. 5, 1891.

Claim 3 follows:

In a printing press the combination with a type bed and a movable platen of electromagnets and armatures for effecting the main movement of said platen and a supplemental electromagnet and armature suitably connected with said platen for effecting its final movement to produce the impression.

Electrolytic Diaphragm, A. J. Lehman, New York, N. Y., 483,692. Filed July 6, 1891.

Consists of a porous substance having its pores filled with an amorphous non-gelatinous precipitate; said precipitate being preserved in a moist state by treatment with a deliquescent salt.

Hygrometric Valve Controller, C. W. Rogers, Chicago, Ill., 483,725. Filed Dec. 24, 1891,

A hygrometric device adapted to close an electric circuit for the purpose of automatically controlling the valve.

Door-Lock Switch for Electric Lights, O. Green, Toronto, Canada, 483,739. Filed April 8, 1892.

Electro-Therapeutical Instrument, J. W. Molière, San Francisco, Cal., 483,745. Filed Sept. 14, 1891.

An electrostatic machine for physicians' use employing an air-tight case and an air blast apparatus for forcing air into the case.

Insulated Rivet, W. S. Hull, Sheffield, Ala., 483,806. Filed May 2, 1892.

Employs an insulation of asbestos.

Railways and Appliances :—

Trolley Catcher, J. J. Hoppes, Springfield, Ohio, 483,689. Filed Feb. 24, 1891.

Consists of a jointed or flexible trolley arm, a portion of which is adapted to assume an unusual position which will set in operation mechanism to withdraw the trolley arm from its normal position to one clear of the conductor.

Electric Railway, W. G. Murphy, Jr., Marysville, Cal., 483,856. Filed Sept. 30, 1891.

Employs a connector formed of two sliding bars, each carrying a grooved roller for making contact with the cable in the conduit, one bar raising the cable and the other depressing it.

Switches and Cut-Outs :—

Electric Switch, D. H. Armstrong, Long Island City, N. Y., 483,704. Filed June 11, 1892.

Comprises an insulating base, a centre post connected with the thumb-piece at the outer end and having a square inner end, a sleeve on said post and segmental cam on said sleeve, a contact spring connected with the main line in contact with the square end of the sleeve and two contact springs adapted to be moved in or out of circuit with the cam.

Electric Switch, A. Ekstrom, Lynn, Mass, 483,712. Filed Nov. 10, 1890.

Employs a contact maker and spindle with a fixed cam thereon and a reversely shaped non-rotating cam pressed into engagement with the fixed cam.

Electric Snap Switch, A. Ekstrom, Lynn, Mass , 483,713. Filed April 7, 1891.

Employs fixed contact surfaces and a reciprocating bridging contact, movable perpendicularly to said surfaces.

Electric Switch, H. T. Paiste, West Chester, Pa., 483,863. Filed May 14, 1891.

A quick brake switch whose action is independent of the rapidity of movement of the handle.

Telegraphs:—

Police Telegraph System, C. A. Rolfe, Chicago, Ill., 483,768. Filed May 6, 1892.

Provides means whereby any irregularity or neglect in the sending of a report can be readily detected by the officer in charge.

Telephones and Apparatus :—

Telephone Receiver, F. Gross, Montreal, Can., 483,718. Filed Jan. 18, 1892.

A rubber air cushion adapted to be placed about the mouth of a telephone receiver.

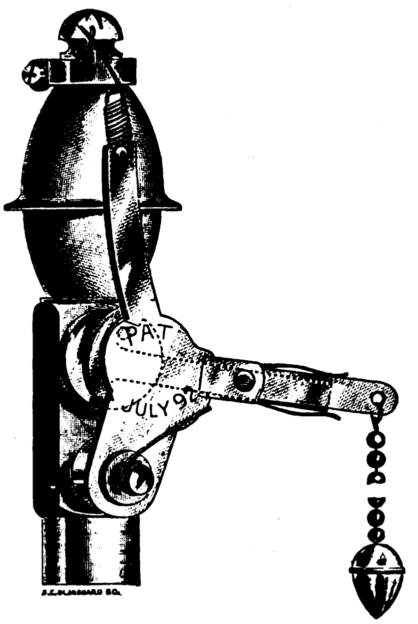
TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

Advertising is to trade what electricity is to traction—an investment that means economy and profit.

THE IONA SAFETY PENDANT BURNER.

We illustrate herewith the Iona safety pendant burner, which possesses several novel features. In this burner there is but one contact made in lighting and extinguishing the gas. This result is accomplished by the wire spring passing over the electrode on its return from the lighting pull, and on the off pull by a very ingenious arrangement of the valve cam, the electrode not being touched at all. The on and off pulls are decidedly different, and one can readily tell even in the dark whether the gas valve is open or closed. There is no possible danger of mistake on this point. These burners are made in the best possible manner, the valves being hand ground and always perfectly tight. The movements are simple and positive, and there is no ratchet or complicated spring to get out of order. This burner is being placed on the market by the Redding Electric Company, 41 Federal street, Boston, who have already received a number of large orders from the trade.



Iona Safety Pendant Burner.

THE GENERAL ELECTRIC COMPANY AT THE CLEVELAND CONVENTION.

The exhibit which the General Electiic Company will make at the Street Railway Convention promises to be of especial interest to street railway men. Among other things it will exhibit a magnificent new special car, which is probably the finest equipped streer car that has ever yet been constructed. This car will have a single truck equipped with two 15 h. p. W. P. 30 motors, regulated by the latest type series parallel controller. They will also exhibit a fine long car mounted on double trucks, equipped with W. P. double 25 h. p. motors, with both forms of control. The car will be equipped with measuring instruments, so that the economy of each method of control can be compared. These cars will be run upon the lines of the East Cleveland Railway Company, and the General Electric Company will furnish tickets to interested visitors.

At the hall will be shown a truck equipped with two 15 h. p. W. P. motors connected with the series parallel controller so that the operation of the motors can be clearly inspected. A dissected W. P. 30 motor will constitute part of the exhibit, clearly showing its great simplicity. Motors of the S. R. G., S. R. F. and Edison No. 16 types will also be shown. In addition a complete line of the new overhead parts introduced by the General Electric Company will be displayed, showing many new features.

Magnificent decorations of incandescent lamps will be made, not only around the hall, but also at the Hollenden Hotel, while a beautiful souvenir hand-book, containing very valuable information on the general operation of electric railways, as well as covering the important features of the General Electric Company's apparatus, will be taken away by all the street railway men there.

THE AHEARN ELECTRIC HEATER.

The electrical trade is well acquainted with the reputation of the Railway Equipment Company of Chicago, for energetically pushing the sale of the material it handles. This activity has in no department been more noticeable than in that of electric heating. Clearly seeing the tendency of the awakening interest in that subject, it obtained two years ago the control of an electric heater which, at the time, was the only practical device of that description made. Having placed hundreds of these heaters in all parts of the country, and having constant calls for an improved heater, and also heaters for other than car use, they investigated for nearly a year the merits of the Ahearn electric heater, and finding it an almost perfect device, they have obtained the entire rights for its manufacture and sale for the entire world. The company is about to issue an illustrated catalogue, showing the Ahearn heater in actual use, and in the meantime they are prepared to give facts and figures of actual results obtained by the use of this convenient and efficient heater. We understand that samples of the heaters are to be shown at the Street Railway Convention in Cleveland.

THE PARTRICK & CARTER COMPANY.

Messrs. Franklin S. Carter, Charles M. Wilkins and E. Ward Wilkins, trading as Partrick & Carter Co., have issued a profusely illustrated 180 page catalogue of their goods, chief among which are their annunciators. Bells, batteries, telegraphic instruments, medical apparatus, etc., also occupy conspicuous positions throughout the pamphlet.

The Partrick & Carter Co.'s needle annunciators are so extensively used and so well known that a detailed description is unnecessary. Within the last year they have added several new features and changed the set-back mechanism entirely. The advantages they claim for the new set-back or tripping mechanism are that it keeps all the needles free at all times on their pivots, and greatly simplifies this, the most troublesome part of all annunciators. The system of guest call and fire alarm has met with unqualified success and approval, and during the last few years they have been crowded with orders for annunciators, combined with these systems.

SPRAGUE ELEVATORS FOR THE NEW POSTAL BUILDING.

The Sprague Electric Elevator Co., 15 Wall street, this city, have closed a contract with the Postal Telegraph-Cable Co. for six Sprague electric elevators to be installed in their new fourteen-story buiding, at the corner of Broadway and Murray streets. Four of these elevators are for ordinary way service, and are to have a speed of 300 feet per minute. The other two are to be designated as "Express" elevators, and are to run at not less than 400 feet per minute under a live load of 1,800 pounds. They are to be operated from current generated by a special plant in the building, but will also be arranged so as to take current from the Edison street mains on Sundays and holidays, when the interior plant might not be running. This contract was awarded after the officers and architects of the Postal Telegraph Co. had given the recent installation at the Grand Hotel in this city a most careful and critical investigation.

AN "ENTERTAINING FEATURE."

Probably the most entertaining feature of the current number of the New York Electrical Engineer is a contribution by John Dennis, Jr., of the staff of the Rochester *Democrat and Chronicle*. It is a detailed description of the new auxiliary fire alarm system, invented by William L. Denio and installed by the Standard Electric Signal Company, of this city. The system is noted for the effectiveness, smoothness and noiselessness of its operation. Mr. Dennis' paper is a careful and exhaustive analysis of the methods of the system, which the reader is aided in understanding by a series of excellent cuts and engravings.—*Rochester* (*N. Y.*) *Herald.*

A BIG WESTINGHOUSE RAILWAY CONTRACT.

The largest contract ever placed at one time in the West was given out last week, when the Westinghouse Electric Manufacturing Company closed a contract with the Chicago City Railway Company for the complete equipment of 61 cars with their single-reduction type motor; also for four 300 h. p. generators for their cross-town lines.

THE CLOVERDALE, ALABAMA, ELECTRIC ROAD.

Mr. H. E. Heller, the secretary of the Cloverdale Land and Development Co., of Montgomery, Ala., writes us that the central section of their road was started on October 3, and that the other part will be in operation by the middle of the month, making a total of seven miles. The cars are equipped with the Thomson-Houston waterproof motor and series parallel controller, and run beautifully, handling 50 to 75 people per car all day long with the utmost satisfaction to the public.

ST. LOUIS NOTES.

The St. Louis Electrical Supply Co. are making a very attractive exhibit at the Exposition in St. Louis. They are showing a full line of Carpenter electric heating appliances, Packard lamps, some of which are of very large candle power, fine testing instruments and other electrical supplies and novelties. They have an electrified bucket of water in which coins of various denominations are dropped; then they politely invite unwary bystanders and the persistent small boy to help themselves—and the result is shocking.

The Municipal Electric Light Co., of St. Louis, show at the Exposition a striking illustration of transmission of power, a Thomson-Houston motor being operated from their circuit and running a Ft. Wayne incandescent generator, which lights up a large number of incandescent lamps, some of which are arranged in the form of a handsome signboard.

The Wagner Electric Mfg. Co., of St. Louis, make a fine display at the Exposition of their alternating and direct current motors and generators. They have a very ingenious electric fountain, the water for which is pumped by a motor operated by alternating current and which attracts a good deal of attention.

The Emerson Electric Mfg. Co. has an exhibit at the St. Louis Exposition of alternating current motors for fans and other work, and a full line of their other railroad, electric light and station specialties.

NEW ENGLAND NOTES.

The Corliss Steam Engine Company, of Providence, R. I., are at present building two engines for the Interstate Consolidated Rapid Transit Railway Company, of Kansas City, one of which is a single engine with cylinder 36-inch diameter by 60-inch stroke, and the other a tandem compound engine with cylinders 22-inch and 40-inch by 60-inch stroke. Six of their well-known Corliss patent vertical tubular boilers, each of 250 h. p., will accompany these engines. The Corliss Company have recently started the immense engine of 2,400 h. p., which they installed in the new factory of the Fall River Iron Works Company, and which has attracted wide attention owing to its magnitude. The engine is triple expansion and has six cylinders, two sets of three tandem, the dimensions of the cylinders being as follows, all with a stroke of 60 inch : Two high pressure, 23½-inch diameter ; two intermediate, 36½-inch diameter ; and two low pressure, 54-inch diameter. The fly-wheel is 28 feet in diameter, with a face measuring 15 feet 4 inches wide, from which a number of belts are driven. When steam was let into this monster, it started off just as smoothly as if it had been running for years.

The Whitney Electrical Instrument Company, of Boston, have left their old offices at 35 Hartford street, and will hereafter be found at 146 Franklin street. Mr. Harry Kellogg has again become identified with this company, and will hereafter have charge of the selling department. The factory of this company has also recently been removed from Manchester, N. H., to Pennacook, N. H., and they now have very largely increased facilities for the manufacture of their instruments which are daily growing in popularity, as reliable and at the same time extremely reasonable in price.

C. S. Knowles, of Boston, has recently put on the market a new compound, which he calls "American Chatterton Compound." As is well known, Chatterton compound has been extensively used abroad for insulating purposes, but hitherto has not been much used in this country. Mr. Knowles claims that his compound is approximately the same as the English—which has always had a high reputation—but is considerably purer and better. He has already supplied a large quantity of this material, and it has given the best of satisfaction.

The American Electrical Works, of Providence, R. I., celebrate every public and national holiday by issuing some proclamation or brochure appropriate to the occasion. This week they have sent out to all their friends a tasteful reprint in red and black of the chart or globus of Martin Behaim, of 1492, with a star to indicate were the American Electrical Works would have been found had Columbus steered north instead of allowing his attention to be distracted by a flight of Rhode Island clams about to winter at Saint Augustine.

The Electric Railway Engineering Company is the name of a new company just started with headquarters at room 88, 180 Summer street, Boston. They have secured a corps of competent engineers, and are prepared to do general engineering for the designing and construction of power plants, for electric railway, lighting and other stations, and will also pay attention to steam plants and water-powers. Mr. J. F. McGowan and Mr. A. U. Jaasted are connected with the company, both of whom have had a long and varied experience in general electrical engineering, and are well adapted to manage successfully the affairs of the company which they have just organized.

Mr. Maybin W. Brown, well known in electrical circles, as formerly president of the Eastern Electric Supply and Construction Company, has gone into the supply business for himself, under the title of M. W. Brown & Co., with headquarters at 620 Atlantic avenue, Boston. Mr. Brown has a large acquaintance amongst the electric fraternity, and has, we believe, secured a number of valuable agencies.

Mr. F. H. Underwood, president of the Underwood Manufacturing Company, of Tolland, Conn., will hereafter make his headquarters at 126 Pearl street, the Eastern office of the company, and will hereafter take entire charge of the New England business himself. Mr. Underwood will be glad to see all his old friends at his new address.

This office was favored with calls from several old friends during the past week, amongst whom were Messrs. Ralph L. Shainwald and Frank S. De Ronde, of the Standard Paint Company, of New York ; Mr. Frank Harrington, of New York, and Mr. Charles Dutton, of New York.

WASHINGTON NOTES.

The Hanson Battery, Light & Power Co. have been remarkably successful in Washington with their primary battery on a great variety of work, and in order that the Hanson Company may devote itself to its own work of supplying the demand all over the country, a local company has been formed which will take over and develop the large local business. Mr. Aldrich's brilliant demonstration with his launch on the Potomac has brought a flood of inquiries on the subject.

The Bliss Engineering Company, of Washington, D. C., are now wiring for two hundred and fifty lights in a large new office building located at Ninth and F streets, and the private residence of Chris. Heurich for two hunded and fifty incandescent lights, eighty burglar alarm outlets and twenty-four automatic gas burners ; also the residence of Rev. Chas. Stakley.

NEW YORK STATE NOTES.

Cohoes, N. Y.—The central lighting station has recently placed two new dynamos in line to meet increased demands for lighting. The new club house of the Cohoes wheelmen, the city recorder's offices and the private residences of J. W. Hines and George R. Wilson are all to be equipped with incandescent lamps.

The new alumni building of the Rensellaer Polytechnic Institute is being wired for incandescent lighting, the current at present to be supplied by the local electric lighting company, but the wiring is arranged especially for an isolated plant, which the building committee expect to put in at some future time.

West Troy, N. Y.—The citizens will have submitted to them for voting upon a proposition to tax the village for $6,500 additional in order to erect a new station more central than at present and to provide for such additional facilities as may be required to add to the illumination of the village streets.

The Troy Orphan Asylum, now in process of erection on Spring avenue, is to have a complete system of electric bells and lighting from an isolated plant. The large clothing store of W. & M. Gross has also been completely wired for an isolated plant, and is now in full operation.

Mechanicville, N. Y.—The poles for the new system of lighting the town are now being distributed through the streets, and the work may at last be considered fairly under way, as sufficient business has been contracted for to make the plant a success.

Mr. W. J. Morrison, Kirk Building, Syracuse, N. Y., representing the Fort Wayne Electric Co., reports business as first-class. He has just closed a contract for 750 incandescents for Springville, N. Y.

Mr. W. H. Brenner.—The friends of Mr. W. H. Brenner, formerly with the Edison Company in Canada, will be pleased to hear that he has been recently appointed electrical engineer to the Montreal Street Railway Company.

NEW YORK NOTES.

Mr. A. de Castro, 31–33 Pine street, New York, issues a preliminary circular of the Anglo-American Union, Ltd., London and New York. Mr. de Castro, as engineer and general manager, announces the readiness of the company to supply telephones and telephonic apparatus for export only. The capital stock is stated as £1,000,000. The circular of the company includes a series of illustrations of telephones and apparatus embracing several familiar American types. Further information of the progress of the Anglo-American Union, Ltd., will be interesting to exporters of telephones.

Mr. Hammond, of the Supply Manufacturing Co., Pittsburgh, Pa., was in New York, last week. He reported that he had sold in the last 10 days more of the commutators which his company makes than can be turned out in two months. Many sales are directly traceable to The Electrical Engineer, one alone amounting to $1,000.

Col. W. E. Sheldon, treasurer of the Fitchburg Engine Co., has just closed a contract with the Chemical Paper Co. of Holyoke, Mass., for seven 75 h. p. engines. This certainly speaks well for the persuasive abilities of the salesman, or the good qualities of the engine; perhaps both.

WESTERN NOTES.

Taylor, Goodhue & Ames, 827 Monadnock Building, have taken the exclusive agency for the entire output of the Nutting Electric Manufacturing Co.'s arc lamp for both direct and alternating circuits, street railway, power and series arc service. This lamp is of very remarkable and unique construction; its feeding mechanism contains no clutches, clockwork, gears or other mechanical feed, this being regulated by the heating effect of a shunt circuit. There is a pin whose ends are embedded in a disc of wax, which it permits to revolve and feed the lamp as the heat of the pin varies. This lamp has received exhaustive tests at the hands of Mr. Carl K. MacFadden, electric light inspector of the Chicago and North Western Railway Co., and it is claimed possesses meritorious features not secured by any other construction.

Mr. C. B. Osgood, one of the well-known gentlemen in electrical circles, in Chicago, formerly connected with the Westinghouse Company, as selling representative for the railway department, has associated himself with the Premier Steel Co. of Indianapolis, and has secured the general sales agency for the United States for the Premier electric elevator and also for the hydraulic and steam elevators manufactured by this company. Mr. Osgood has had many years' experience in the elevator business, and is thoroughly posted in all particulars of this branch of work, eminently fitting him for the new enterprise he has undertaken. Mr. Osgood has taken a handsome suite of offices at 319 and 320 Manhattan Building, where he will appreciate a call from his many friends.

The Rice Machinery Co. are now permanently located at their new quarters, 166–174 South Clinton street, having removed from their old quarters, 63 and 65 South Canal street, Oct. 1st. This concern are now making a specialty of complete shafting equipments for electrical generating plants, and with the increased facilities and heavy machine tools recently added, are in a position to handle contracts of any size. They are representatives and general agents for the Dodge Manufacturing Company, of Mishawaka, Ind., and are pushing the sale of the Dodge patent split disc friction clutch pulleys and cut-off couplings, also the Dodge special dynamo pulleys.

The Electrical Supply Co. are drawing crowds every afternoon by their Mongolian and Celestial exhibit in their handsome store on Michigan avenue, where can be seen a Chinese laundry under full swing in which all the heating is done by means of electricity, everything being in charge of Chinamen, who handle the invisible fluid as if they enjoyed it. The progressive enterprise of this company is astounding, and they always let people know when they have anything good.

Mr. A. A. Forman, superintendent of the Iron Mountain Electric Co., of Iron Mountain, Mich., was among the Chicago visitors last week. Mr. Forman has recently been making additions to their plant, and among other machinery has installed one of Stillwell's feed water heaters, which he purchased through seeing the announcement in the advertising columns of The Electrical Engineer.

Mr. F. E. Drake, selling representative of the Standard Electric Co., 313–317 South Canal street, reports that his company are exceedingly busy filling the large contracts recently secured by them. The Standard system of arc lighting is becoming very popular.

Clark & Marshall, 413 Rookery, Chicago, are handling a line of fine specialties, including Boston incandescent lamps, Arnold flexible brackets, Cope come-alongs and Dow adjustable hangers, and are meeting with good success with all of them.

The Railway Equipment Co., Pullman Building, Chicago, are pushed to their utmost capacity filling orders for electric railway supplies of all kinds. The line of Ahearn electric heating appliances, which they are placing on the market, are also meeting with a very extensive demand. Their factory at Mansfield, Ohio, is now well under way to supply the call for these goods and to keep up with the immense trade they are doing in their patented railway specialties, of which they control a large number of novel and valuable specialties. Mr. Adams, of the company, is now at the factory pushing matters there and looking after the turning out of the goods.

The Central Electric Company are about to handle the Iona porcelain rosette. This rosette was illustrated in The Electrical Engineer a short time ago. The cap is removable, and is replaced by a bayonet catch, and does not require a screwdriver. The pin and bracket mill of the Central Electric Company is working full force and turning out thousands of pins and brackets. These goods are made from second growth white oak, sawed with the grain, making them tough and durable. The Central Electric Company are selling large quantities of Acme lead cables, made by the Okonite Company, and carry it in stock to fill requirements.

The Sunbeam Incandescent Lamp Co. is probably the first to make any radical departure from the familiar "pear" shape form of bulb. Their "Acorn Sunbeam" is meeting with a large sale for decorative and other purposes. It has the same "long life" and efficient essentials that have for so long distinguished the regular Sunbeam lamps.

The Hay-Horn Manufacturing Co. are getting a great many orders both from the East and West for their well-known bells. These bells, they claim, are the cheapest, simplest, and most efficient made. They have just issued a handsome new price list of these goods, which show the various forms and some weighty testimonials.

Wm. Hood & Co., 239 La Salle street, managers of the Chicago office of the Electric Manufacturing Co., of Oconto, Wis., have shipped out a large number of orders for Brilliant incandescent lamps during the past few weeks. These lamps, they state, are giving good satisfaction and repeat orders are numerous.

J. H. Siegrist, Jr., & Co., room 18 Laclede Building, St. Louis, have sold to the Cass Ave. and Fair Grounds Railway Co. a 250 h. p. Ideal engine; to Smith & Davis Manufacturing Co., St. Louis, a 100 h. p. Ideal, and to the Columbia, Ill., Electric Light Co., a 70 h. p. Ideal.

Mr. W. W. Borst, superintendent of the Denver Consolidated Electric Co., recently spent several days in St. Louis inspecting the enormous electric lighting and railway plants in that city. Mr. Borst was much pleased with what he saw while there.

The Buckeye Electric Co.'s representative at Chicago says that "Not a wave of trouble rolls across his peaceful breast," with one exception, namely, the inability of his company to keep even with orders, which swoop in on him from all directions.

Mr. W. R. B. Wilcox, whose articles on electric heating attracted considerable attention recently, is going East, to Boston, where he intends taking a complete course in architecture at the Massachusetts Institute of Technology.

The Great Western Electric Supply Co. are busy in all branches of general supplies for lighting and power work. They are receiving orders for a good many generators and Detroit motors for which they are agents.

Mr. J. L. Barclay has returned to Chicago after an absence of three months which he spent with his family among the principal Eastern summer resorts, where he has been storing up ozone and energy.

Mr. Carl K. MacFadden, electric light inspector of the Chicago Northwestern Railway Co., is putting in quite an extensive depot lighting plant which he expects to be a model when completed.

The Simpson Electric Mfg. Co., 39–41 West Washington street, are putting on the market a new 10-light incandescent dynamo on which they expect to have a large run.

The Rabich Fan and Motor Manufacturing Co. has been incorporated at East St. Louis with a capital stock of $10,000, by Bruno B. Herrman, Wm. Rabich and G. Karne.

Mr. Dillworth Richardson, general manager of the Carpenter Electric Heating and Mfg. Co., of St. Paul, was among the recent visitors to the World's Fair city.

Sargent & Lundy, electrical engineers, Monadnock Building, Chicago, are busily engaged finishing up several important contracts that they have had on hand.

Mr. Harry Howell has accepted a position as cashier and bookkeeper with Wm. Hood & Co., managers of Chicago office of the Electric Manufacturing Co.

The Electric Appliance Co. report great activity in all lines of their business. They are working overtime with a largely increased force, and are only enabled to keep up with their orders with great difficulty. They also seem to be crowding the factories which they represent to their utmost. The Elkhart transformer factory is working day and night. The Packard Lamp Company are crowded almost beyond their capacity, and the Paranite people are doubling their force.

The Knapp Electrical Works are having quite a run on their specialties this month, and business in general electrical supplies is also exceedingly active. Safety wire appears to be quite a favorite and the orders for Perkins lamps are large. They are doing a steady increasing business all the time and the outlook is very bright.

Mr. Geo. Meeker, manager of the Chicago office of the New York Insulated Wire Co., is a busy man these days. The large contract secured by this company for the wire at the World's Fair is being rapidly filled, and Grimshaw wires and cables are receiving their full measure of attention.

Mr. H. H. Humphreys, who for some time was the representative of the Edison Electric Co., in St. Louis, has now opened up an office at No. 209 Globe-Democrat Building, in that city, and is representing the Western Electric Co.

PHILADELPHIA NOTES.

The Camden, N. J., Electric Railway.—For some years past the Camden Horse Railroad Co., of Camden, N. J., have been operating their electric cars with power rented from the Camden Electric Light Co. They concluded, finally, to put in their own station, and after a thorough investigation, placed an order with Messrs. M. R. Muckle, Jr., & Co. for two 12-inch and 20 x 12 inch Westinghouse compound engines to be run under 125 lbs. steam pressure and with a condenser. The station is not yet completed, but early one morning last week the large engine at the electric light station broke down just at the moment when the relay engine was being overhauled and was consequently not ready for duty. The new station had only had steam raised for the first time the day before, but fortunately one of the new generators was standing belted to one of the engines, and hasty connections were made to the line and the engine and the dynamo started to see if anything could be done. The result was so entirely satisfactory that after running two days on the single engine and dynamo it was decided to put in operation at once the extension of the line to Merchantville, which up to this time had never had a car over it. This loaded the one engine up pretty thoroughly, the ammeter reading as high as 210 amperes at times, so that all hands were rather anxious lest something should give way. After a consultation it was decided to abandon the electric light station altogether and the old generator was accordingly removed from that building to the new station, and now both engines and dynamos are running and handling the work smoothly and satisfactorily. This means that the finishing of the station, connecting up of the condenser, etc., will have to be done between two and five o'clock in the mornings, since no stop can be made on the road. The improvement in the service has been immediate and marked, the voltage being well maintained at all points of the line.

Warren, Webster & Co., 491 North 3d street, Philadelphia, Pa., sole licensees for the Williames vacuum system of steam heating, without back pressure upon the engine; proprietors and manufacturers of the Webster vacuum feed-water heater and purifier, report the following orders during the past month of September:

Enterprise Machine Co., Minneapolis, Minn.; Burtis, Patterson Sargent Paint Co., Cleveland, Ohio; Oatman Bros., Dundee, Ill.; Armour & Co., Chicago, Ill.; Morrison-Plummer Co., Chicago, Ill.; Racine Hardware Co., Racine, Wis.; National Casket Co., Hoboken, N. J.; E. Z. Wallower, Joplin, Mo.; Republic Iron Works, Pittsburgh, Pa.; American Hosiery Co., New Britain, Conn., Escanaba Lighting Co., Escanaba, Mich.; Union Wire Mattress Co., Chicago, Ill., Wilson Distillery Co., Highspire, Pa.; Watsontown Boot and Shoe Co., Watsontown, Pa., United States Iron and Tin Plate Co., Demmler, Pa.; Germantown Spinning Co., Germantown, Philadelphia, Pa.; Western Electric Co., Chicago, Ill.; The Swift Manufacturing Co., Columbus, Ga.; Swift & Co., South Omaha, Neb.; Swift & Co., Chicago, Ill.; Chas. T. Bainbridge's Sons, Brooklyn, N. Y.; Bamford Bros., Paterson, N. J.; H. P. Nail Co., Cleveland, Ohio; Pencoyd Iron Works, Pencoyd, Pa.; Mechanical Fabric Co., Providence, R. I.; Société Anonyme, Antwerp, Belgium; Jonathan Clark Building, Chicago, Ill.; Knight & Jillson, Indianapolis, Ind.; Detroit Sheet Metal and Brass Works, Detroit, Mich.; Smith Building, Chicago, Ill.; The Wm. Cramp & Sons Ship and Engine Building Co., Philadelphia, Pa.

They have just issued a new catalogue, and state that they will visit plants at their expense, and also furnish their apparatus upon trial.

The Reading Railroad Company's Terminal Station.—Of isolated contracts, probably none has been let in the last few years of the importance and general character of that for the Reading Terminal Railroad Company's new station at Philadelphia. The whole of this work has been in charge of Messrs. Wilson Bros. & Co., engineers and architects, and the specifications which they issued for the plant were remarkable for their thoroughness and strict attention to detail. The exact amount of the various bids is, of course, not made public, but there is little doubt that they were all in the neighborhood of sixty thousand dollars. The plant calls for the installation of ten 30-light dynamos and 270 arc lamps to be driven by five compound engines, each driving two dynamos. The whole of the work from the station for about three-quarters of a mile out is to be laid in conduit underneath the ballast on the road-bed so that no wires shall be above the surface. The lamps are all so divided upon the circuits that 5 out of the 9 circuits may be disabled without extinguishing the total light at any point. The competition for this plant was very close, but was finally secured by the Western Electric Co. of Chicago, who will use for the purpose their "high tension" arc system. The order for the engines and steam piping for the plant has been placed with Messrs. M. R. Muckle, Jr., & Co., who will install five 10 inch and 18 inch by 10 inch Westinghouse compound engines. The contract calls for the work to be completed within sixty days, and this plant will certainly take rank as one of the finest in the country.

Mr. G. H. Fisher, Philadelphia agent for Chas. A. Schieren & Co., says there was never such a demand for their "Perforated" electric leather belting as at the present time. During the past three months business has increased over 25 per cent. over the same months of 1891. Mr. Fisher has recently collected quite a number of valuable testimonials from those using Schieren's belting, one of which we publish below.

Altoona Manufacturing Co. Altoona, Pa., Oct. 1, 1892.

Charles A. Schieren & Co.
226 North 3d street.

Gents.—I have the honor of acknowledging your esteemed favor of the 15th ult., which I have now before me and carefully note contents, and in reply would say that we are very happy indeed to inform you that the six 15-inch double perforated endless belts which we purchased from you for use at the Altoona City Passenger Railway power house, and which have been in constant use for about one year, have given entire satisfaction in every respect and continue to run without sign of distress.

Yours truly,
M. A. Green.

The Supply Manufacturing Co., of Pittsburgh, Pa., will be ably represented at the Cleveland convention by its vice-president, Mr. R. R. Hammond. It will have a fine display of commutators of which it makes a specialty. Although not a young company, it has recently been reorganized with live and energetic men at the head who are bound to make a success of anything which they undertake. This is proven by the enormous increase made in their business during the past few months, which is compelling them to move into much larger quarters on Water street. Their new president, Mr. G. R. Stuart, is a man of wide business experience, having been for over nine years interested in the natural gas industry as president of the Saltsburg Gas Co. He is a civil engineer by profession.

The Fort Wayne Electric Co. have sold through their Philadelphia agent, Mr. G. A. Wilbur, a 650 incandescent light plant to the Frederick, Md., Electric Light and Power Co.; one 60-light Wood arc plant complete to the borough of Middletown, Pa.; one 25-light Wood arc plant to Walker & Kepler, for the county prison, and an additional 60-light Wood arc dynamo to the Suburban Electric Light Co. of Tacony, Pa.

J. L. Hayes & Co., of Pittsburgh, have opened an electrical repair and work shop at 830 Liberty street over the Robins Electric Co.'s store. They will make a specialty of the rewinding of armatures, repairing of motors and dynamos, model making and experimental work. Mr. John J. Fisher, foreman of the shop, is a thorough mechanic, and has been connected with the Westinghouse Co. for several years.

Mr. J. Stanford Brown, one of the best-known consulting electrical engineers in this part of the country has, in addition to his office in New York, opened a branch at the corner of Cooper's Creek and Federal streets, Camden, N. J.

The Commonwealth Electric Co. have the contract for wiring the Lafayette Hotel for 200 incandescent lights. They will also refinish all chandeliers and put in a large number of combination fixtures.

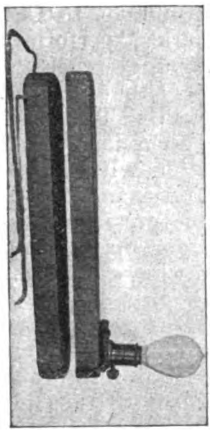
Mr. J. W. Parker has sold a 300 h. p. Ball automatic cut-off engine to the North Hudson Elevated Railway Co., of Hoboken, N. J., making the third engine of this size placed in this station within five months.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.***

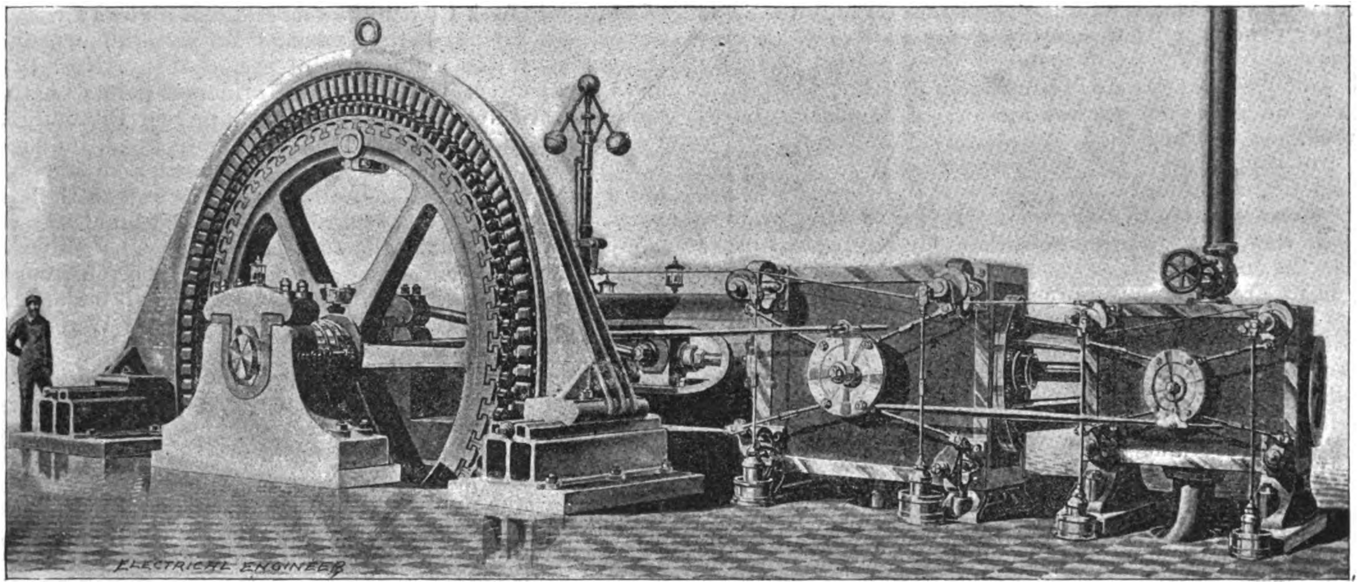
THE
Electrical Engineer.

VOL. XIV. OCTOBER 26, 1892. No. 234.

THE NEW 500 H. P. DIRECT CONNECTED WESTINGHOUSE ALTERNATOR OF THE NARRAGANSETT ELECTRIC LIGHT CO.'S STATION, AT PROVIDENCE, R. I.



LIVING in a city celebrated for its enterprise, Mr. Marsden J. Perry, vice-president and general manager of the Narragansett Electric Light Co., of Providence, R. I., has long since earned the reputation of having one of the best equipped and best operated electric central stations in the country. The success achieved may fairly be claimed to be due to Mr. Perry's policy of having nothing but the highest quality of men and material in and about his station, with the result that the company has found its business constantly increasing and calling for additional facilities. When, some time ago, the need for increased alternating apparatus became apparent, Mr. Perry, who had long been an advocate of the slow speed Corliss engine, resolved to adhere to this type of engine, but to go a step further and gain still greater economy in fuel consumption and space by the adoption of direct connected dynamos in place of the belt with countershaft. The success already achieved with direct connected machines in continuous current work here and abroad encouraged him in the adoption of a like plan for alternating current work with the result that an order was given to the Westinghouse Electric and Manufacturing Co. for a 500 h. p. alternate current generator, to operate at 2,200 volts.



NEW 500 H. P. DIRECT CONNECTED ALTERNATOR, NARRAGANSETT ELECTRIC LIGHT CO., PROVIDENCE, R. I.

The accompanying illustration is made from a photograph of the generator now being erected by the Westinghouse Company in the Narragansett Company's station at Providence. The machine is of the internal-multipolar type, built to meet exacting conditions of speed and regulation, and embodying the result of years of experience and experiment on the part of the Westinghouse engineers. As shown, the dynamo is coupled direct to a Reynolds-Corliss compound engine of 48-inch stroke, built in accordance with the latest designs, expressly for this installation, by the E. P. Allis Company, of Milwaukee, and now being erected under the immediate direction of Messrs. Remington & Henthorn, resident engineers for the Narragansett Company.

The generator, complete without the engine, weighs about 60 tons, and measures over 20 feet in diameter between the extreme edges of its circular field. On the armature there are over one thousand pounds of copper, while nearly five miles of wire are used for the field winding.

In order to comply with the Westinghouse new standard of 7,200 alternations, and at the same time run at the speed for which the engine was designed, viz., 90 revolutions per minute, the armature was constructed with a diameter of 16 feet. It is built up of wrought iron E-shaped sheets, bolted together and then fitted into what is practically the rim of a heavy cast iron fly-wheel. The projecting teeth of the armature are T-shaped and numerically equal to the pole-pieces of the field. Each tooth is surrounded by a simple lathe-wound coil, which, having been pressed into shape, is held rigidly in place by insulated strips driven between the coils and beneath the "T" edges.

The advantages of this armature, which is a type peculiar to the Westinghouse Company, are so noticeable as to be worthy of special remark. They are: The high insulation attainable in machine-wound coils, which in this machine has been made safe for 20,000 volts; the ease with which any single coil may be replaced without disturbing the others, and at almost no expense; the immunity from accident in case of overload or abnormal heating of the conductors, as no coil or wire can break loose and abrade insulation, or catch in the pole-pieces of the field; the small air space, only ⅜ of an inch, between the face of the pole-pieces and the surface of the armature, whereby the resistance of the magnetic circuits is greatly reduced, and the efficiency of the machine increased. To this must be added the freedom from liability to accident in handling, due to the entire absence of wires on the surface of the armature, and the increased ventilation secured by the use of a hollow armature and the large percentage of conductors exposed to the air—hence increased current capacity, with consequent higher efficiency.

The field pieces are lathe wound on bobbins, and then bolted into place on the pole-pieces. The winding is a simple one, all regulating and compensating being done by variation in the amount of exciting current, which is supplied from a separate dynamo.

In order to maintain a constant potential at the brushes of any generator, it is necessary to vary the field excitation when the load varies. The fluctuation of current in the fields of this machine is secured by the use of two transformers, which are placed diametrically opposite on the hub of the armature. These transformers are in multiple-series with the main circuit and their secondaries are connected with a commutator on the shaft. The rectified current thus derived will vary with the load of the generator, for if the load is increased there will be an additional flow of current on the main and a drop in the potential of the generator; the increased current thus introduced in the primary of the transformers will of necessity increase the secondary, *i. e.*, the rectified current. This last-mentioned current is used to partially excite the fields of the exciter, which, under the conditions stated, will have its E. M. F. raised, and hence send a larger current through the fields of the generator itself, causing a rise in its voltage and thus counteracting the drop due to the increased load. By this unique arrangement a comparatively easy, and yet at the same time very perfect method of regulation is secured.

The commutator and collecting rings, 28 inches in diameter, are placed side by side on the armature shaft, and so constructed that any one commutator segment, or a single ring, may be removed without disturbing any other than the one selected.

There are four sets of brushes, two for the rectified and two for the alternating current. They are supported from rods 90 degrees apart, projecting from a brush holder (not seen in the engraving), which rests on a base of its own, and, though encircling the shaft, is entirely independent of it.

Perhaps as valuable a feature of the generator as any is the simple yet satisfactory arrangement for separating the field and armature for purposes of cleaning, repairing, etc. The entire field is supported just below its mid-points upon two slides, running parallel to the shaft; by means of tension screws the whole field can be moved along the slides until completely withdrawn from the armature, thus giving easy access to any part of the machine. The generator, as stated above, is built to give 373,000 watts, 500 electrical horse power, at 2,200 volts potential, and has a guaranteed efficiency of 92 per cent.

A ST. LOUIS ELECTRIC CLUB.

STEPS toward the permanent organization of an electric club were taken at the last meeting of electricians at the Mercantile Club, of St. Louis. A committee of 10 was appointed to draw up a constitution and by-laws to be voted upon at the next meeting, which will be held on the second Friday in November.

NEW YORK—CHICAGO.—THE OPENING OF THE LONGEST TELEPHONE LINE IN THE WORLD.

THOROUGHLY delightful was the reception awaiting those favored with the American Telegraph and Telephone Company's invitation to attend the formal opening of the new telephone line between this city and Chicago, on October 18. Forty-two receivers were placed about the room and the guests listened to music, recitations and conversations. The exercises opened with the transmission to Chicago of "America," performed on a cornet, and its repetition immediately afterward from the other end of the line. Mr. John E. Hudson, president of the American Bell Telephone Co., and of the Long-Distance Company, then introduced Mayor Grant, who held a short conversation with Mayor Washburn, of Chicago, after which Prof. Alexander Graham Bell, who honored the occasion by his presence, conversed with Mr. William H. Hubbard, one of his early associates in the telephone enterprise, and who was at the Chicago end of the line.

Notwithstanding the fact that 42 receivers were included in the circuit, the articulation was perfectly clear and distinct, thus demonstrating the power of the transmitters and the admirable proportions and arrangement of the line circuit.

The long-distance telephone line between New York and Chicago extends 950 miles from the main office of the American Telephone and Telegraph Co., No. 18 Cortlandt street, New York City, by the most direct highway routes across New Jersey, Pennsylvania, Ohio and Indiana, and terminates at the main office of the company, Nos. 105, 107 Quincy street, Chicago. The principal points on the main line are Newark, N. J., Harrisburg and Pittsburgh, Pa., Cleveland and Toledo, Ohio and South Bend, Indiana.

In the Eastern States connecting lines reach all important points from Portland, Maine, on the east to Buffalo north and Washington, south. In the West branches are completed, or substantially so, from Chicago, to Milwaukee, Wis., and from Toledo to Detroit, Mich. Through these branches and through connecting lines all important points in Ohio, Indiana, Illinois, Michigan and Wisconsin will soon be reached.

The New York-Chicago line is 950 miles in length, and is constructed in the most substantial manner. The poles are of cedar and chestnut, 35 feet and upwards in length, and average about 45 in number per mile; making the total number of poles 42,750.

To determine the feasibility of transmitting speech over the heretofore unapproached distance of nearly 1,000 miles, a special experimental circuit, consisting of two No. 8 hard-drawn copper wires has been constructed. This wire weighs 435 pounds to the mile, and the circuit contains 826,500 pounds of copper. A circuit of the size generally used for telephone service would weigh less than 200,000 pounds.

The use of cables, which are so detrimental to long-distance telephone tranmission, has been avoided to the utmost possible extent, and they are used in the line only at the terminals and at the river crossings in the immediate vicinity of New York. Prior to the construction of this line, the limit of successful transmission did not exceed 500 miles.

At the conclusion of the telephonic exhibition the guests were handsomely entertained at luncheon by the officers of the Long Distance Co., and each was presented with a souvenir, consisting of a helix of the No. 8 copper wire, of which the line is constructed, with miniature receivers attached to the ends. The line is now open for regular business.

TWISTING MAGNETISM.

BY

Townsend Wolcott.

Mr. S. W. Balch's note on "Twisting Magnetism" seems to have aroused considerable interest, but in the humble opinion of the writer both the gentlemen who have offered explanations of the non-production of current in the apparatus shown in Fig. 3 are in error. Mr. D. C. Reusch's explanation, if I understand it, explains too much. It would prove that the Fig. 1 apparatus would not give a current, which is somewhat startling in view of the fact that this figure represents one of Faraday's early experiments, in which he obtained a current. This apparatus is, therefore, one of the oldest known forms of generator. Mr. Reusch's quotation from Thompson's "Dynamo-Electric Machinery" does not apply to this kind of generator. I have never seen the whole story of magneto-electric induction summed up in a single sentence, and I doubt the possibility of doing it, at least in the English language. Mr. Steinmetz's explanation is certainly very ingenious, and at first sight very plausible, but the statement that "the magnetic field of a magnet does not revolve when the magnet is revolved, but remains stationary," I cannot endorse. This idea is not a deduction from the fundamental principles of magnetism, and appears to be an independent assumption made for the express purpose of explaining the experiment under discussion, or others of like nature. It will presently appear, however, that it is unnecessary, even for this purpose, besides which it leads us into numerous difficulties if followed out to its legitimate results.

Let the galvanometer in Fig. 1 be replaced by an electrometer and the ends of the wire, instead of being placed in actual contact with the revolving magnet, be brought near it without touching. Then if the field revolve, the electrometer should be deflected (provided it be sufficiently sensitive), otherwise there should be no deflection. But without this direct experiment which might be troublesome in practice, let us investigate other forms of magnets. For the sake of simplicity solely, the magnet in Fig. 1 has been tacitly assumed to be truly cylindrical, symmetrically magnetized, and revolved about its geometric axis. Under these conditions there is no logical difficulty in assuming the field stationary, but neither is there any logical warrant for such an assumption. If, however, the magnet have a cross-section other than circular, for instance square, there would be a current generated just the same (except that it would be slightly pulsatory instead of absolutely constant) but the field could scarcely be said to be stationary in any proper sense of the word. If it still be held that the field does not revolve as a whole, it must at least have internal motions (re-arrangements of lines) in order that the field may bear a constant relation to the iron (or steel) of the magnet. This is certainly a very artificial assumption, made to bolster up the first assumption, a process of reasoning which is never necessary to a true theory.

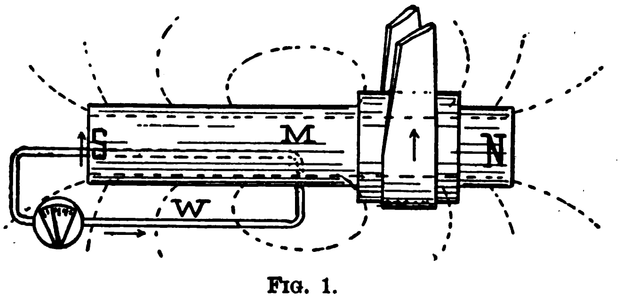


Fig. 1.

Next, suppose the straight bar magnet of Fig. 1 to be replaced by a horseshoe magnet, which rotates upon the axis of *one limb*, the other limb of course traveling in a circular orbit. This apparatus will still furnish current, but I fail to see how, by even the utmost stretching of the meaning of words, the field can be said to be stationary. Further, let the small circle in the subjoined diagram represent the end view of a bar magnet traveling with its axis parallel to itself in the orbit represented by the large circle. Now certainly the field of this magnet follows it around the orbit, whether it be supposed to follow the coincident rotation of the magnet upon its own axis or not.

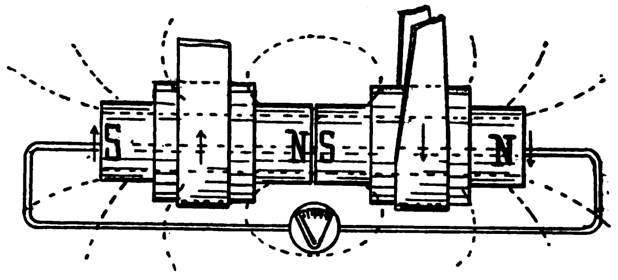
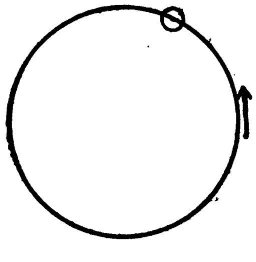


Fig. 3.

Next, suppose the magnet reduced to a filament, and then the whole circle packed full of such filaments, and we have the magnet of Fig. 1 with its field revolving *with* it. I had supposed that every one, from Faraday down, had considered the field of a revolving magnet to revolve with it, and had the contrary statement been made by a person whose opinion is of less weight than Mr. Steinmetz's, I should not have considered it necessary to contradict it so elaborately.

The philosophy of the Fig. 3 experiment is to my mind as follows: Mr. Balch's assumption that a portion of the field revolves with each portion of the magnet is correct, except that he does not mentally divide his field in the way in which nature divides it. He supposes the field of the whole magnet to be cut squarely in two by the plane which divides the magnet, whereas the field should be resolved into two component fields according to the parallelogram of forces, which is the only way that forces can be separated. If this be done we have two separate fields, the same in fact which we have if the halves of the magnet are separated until out of each other's influence.



Let us suppose them so separated, (the conductor being sufficiently long for the purpose) and revolved in opposite directions; no one would expect to get a current. When they are brought end to end the fields are interlocked, and so far as a magnetic needle is concerned they form a resultant, but so far as magneto-electric induction is concerned they still act separately.

The whole Fig. 3 experiment is, in fact, only a particular case of the well-known and very fundamental property of magnets, namely, that if we cut a magnet in two, we have not too halves of a magnet each with one pole, but two half-sized complete magnets, each with two poles.

In 1886 I read before the New York Electrical Society a paper in which this same philosophy was applied to the theory of dynamos, but it does not seem to have taken root.

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VOL. XIV. NEW YORK, OCTOBER 26, 1892. NO. 284.

If it were put to a test to-day in the city of Cleveland, there would be twenty to one in favor of the electric or cable system.—Mayor Rose, of Cleveland.

OPENING OF THE NEW YORK—CHICAGO TELEPHONE LINK.

THE 18th of October, 1892, will always be a red-letter day in the history of the telephone business. On that day there were gathered together in the Telephone Building on Cortlandt St., New York, a large company of representatives of the Metropolitan press, and, at the same time, there was assembled in the office of the Long-Distance Company, in Chicago, a similar gathering of representatives of the press that city. Connecting these groups, a thousand miles apart, were two very heavy copper wires, equipped at each end with a Long-Distance telephone outfit. As a special guest at the New York end was Mayor Grant, and filling the same role in Chicago was Mayor Washburn. Another guest in New York was Prof. Alexander Graham Bell, the inventor of the telephone.

The hour for the formal ceremony had come, and Mayor Grant, in New York, speaking in an ordinary tone, accosted the Mayor of Chicago a thousand miles away. Mayor Washburn's reply came promptly and distinctly. It was ingeniously arranged that their Honors should not have their chat entirely to themselves. At both ends some forty hand telephones were connected in, so that other guests could listen and hear the conversation. In effect, therefore, it was the same as though the two speakers were in the same room, with the two companies of journalists gathered about them, listening to their conversation. And so the two great cities were brought within easy speaking distance of one another; their union was made complete and perfect, and it was duly witnessed. It is safe to say that they will never again be satisfied to live asunder.

An interesting incident was the conversation between Professor Bell in New York and Mr. William H. Hubbard in Chicago. Mr. Hubbard assisted Professor Bell at the Centennial, in Philadelphia, in 1876, when the telephone was first publicly exhibited, and the two have not conversed by wire since that time.

Few will realize what it means to have accomplished this. Only those who have watched the work, who have known the obstacles that have been overcome, the objections that have been met, the electrical and engineering problems that have been solved and the false theories that have been exploded, only those who realize how persistent the effort has been, how wise the generalship necessary to direct all the various forces and bring about a successful result—only these do, or can, comprehend the proportions of this great enterprise which has had so successful an issue.

Be it remembered that this Chicago line, which is double the length of the longest telephone circuit hitherto operated in the world, is but a part of a great system, a link which connects the well-known Long Distance plant, which practically covers New England, New York, Pennsylvania, Maryland and the District of Columbia, with the great cities of the West. It is not New York alone that can now converse with Chicago. Boston, Philadelphia, Baltimore and Washington share the privilege. So, too, do lesser cities. Worcester and Springfield and Hartford and New Haven, Albany and Troy and Syracuse and Rochester, Buffalo and Erie and Pittsburgh and Cleveland; these, and many other cities, because of work previously done, and all planned with a great system in mind, have as much interest in the completion of this thousand-mile link as New York itself.

It is interesting to trace the growth of the telephone business since its small beginning in 1876. It was while the nation was celebrating the completion of its hundredth year that the "still small voice" of the telephone was first heard. Then it was little more than a scientific toy. And yet, in all its essentials, it was the same then that it is to-day. Improvements in apparatus have been made, many and notable. But the essential thing is the growth of the business, the creation of a great commercial enterprise, which has made this scientific toy the servant of man, a well-nigh indispensable agency in the daily life of the civilized world. A great advance was made when, by what is known as the "exchange system," persons living within the limits of a municipality were enabled to communicate with one another. Yet this was but a step. Hardly had it been taken when the need of communication by speech between neighboring municipalities became apparent. This was brought about by combination of effort in each case. Then it was seen that some more comprehensive plan, one that would give uniformity in appliances, in methods and in organization, one that would cover larger areas and bring more remote communities into intercommunication, was needed. The end in view, even yet remote, perhaps, but still in view, was a great national "exchange," one that would enable a business man, sitting in his own private office in Chicago, Milwaukee or Detroit to converse as easily and promptly with friends in Boston or New York or Washington as with those who reside within a mile of his place of business. To accomplish this, the American

Telephone and Telegraph Company was organized, and it has kept steadily at work, always with this ultimate object in view.

THE ELECTRIC RAILWAY CONVENTION AT CLEVELAND.

A LARGE portion of our space this week is devoted to the report of the proceedings of the American Street Railway Association at Cleveland last week. As will be seen, the Convention is largely, one might almost say, overwhelmingly, electrical in its makeup and tendencies, and its proceedings are as much electrical as those of the National Electric Light Association. That this is so, at a very early stage in the art, is matter for hearty congratulation, and is a grand incentive to grapple with the problems and tasks that still await, in even more extensive departments of traction.

With perhaps one or two exceptions the reports submitted by the various committees at the meeting of the American Street Railway Association, were productions of genuine merit, the value of which will be fully appreciated on close scrutiny. The subjects covered by the committee embraced a wide scope of street railway work, and ought to have satisfied even those members who are still operating horse roads, and who have recently been heard to complain that the proceedings of the Association were of little interest to them. In reading the report on Standards for Electric Street Railways, it becomes evident that the art is still in such a pronounced stage of transition, that exact standards at this early date are hardly determinable. The committee has done well, however, to bring together such information as will enable the members to form an opinion based upon the general practice of the day, and the standards suggested in the report may well be taken as a guide in pointing to probable future practice. The proposed standard for rating the capacity of street railway motors, certainly has the merit of simplicity, though it fails to take into consideration the efficiency of the motor, being based solely upon the torque at a given speed. We agree, with the report, that, desirable as it would be to know the efficiency of the motor, it would be difficult to involve that factor in a rating that shall be frequently and properly used. But on the other hand, we do not believe that it would involve much additional trouble to take current and voltage readings during the operation of a car under test, and to thus obtain at least an approximate idea of the efficiency.

The committee report on Experiments on the Expansion of Continuous Rails is noteworthy in that the results therein recorded appear to upset all our preconceived notions on track construction, more particularly that one which, in the past, dictated the necessity of allowing for expansion and contraction of rails with temperature variations. The report is largely based on a record of the work of Mr. Philip Noonan, and, this, if correctly recorded, appears to leave little room for argument as to the feasibility of a jointless rail, a proposition which we are free to say, has not heretofore met with the approval of railroad men of experience. If the method should continue successful, there would appear to be nothing in the way of the rail being made continuous by electric welding. The latter will greatly simplify and reduce the cost of construction, as Mr. Noonan's method, though apparently giving excellent results, must of necessity involve considerable, though we are by no means prepared to say, unless, expense.

The report on Economy of Machine Shops for Electric Street Railways presents a very curious state of facts. We are first struck with the large percentage of roads operating electric cars, which have practically no facilities for making even ordinary repairs, while, on the other hand, it is shown pretty conclusively that the maintaining of repair or machine shops in connection with electric roads contributes largely to economy in operation. While strongly recommending the establishment of such repair shops to take care of ordinary depreciation of railway stock and equipment, the report goes even further and urges the economy of manufacturing, by the railway companies themselves, of supply parts used by them. Based not only upon the results obtained by the electric roads who have tried it, but also on the experience of the older steam roads, it is fair to assume that this recommendation will be carried out by not a few roads in the future. Aside from the patented devices, there are numerous electric railway supplies which can be renovated economically by the companies themselves, and it would be strange indeed if they did not avail themselves of this opportunity of reducing their expenses.

It seems to us a great pity that the movement to organize a supply men's auxiliary association was not successful. The fears expressed as to a control of it by the few strong at the expense of the many weak, are unworthy of the energetic men engaged in an industry so progressive and so diversified. If only to look after the exhibits, such a body is needed. The display at Cleveland was very fine, but the vast majority of those who came to see it were "hayseeds" and women, of whom not one in a million buys street railway or mechanical apparatus. What is wanted is the careful and thorough preliminary canvass of the community, so that when the Association goes to a city with its exhibit, the Supply Secretary has interested by direct appeal every merchant, manufacturer, capitalist, inventor and machinist in the community. That is the kind of *outside* public to be reached, and the only kind that the active operating street railway men themselves want to meet on such an occasion.

Conspicuous Ability.

IT is but giving just credit where it is obviously due to say that the successful establishment of telephone service between New York and Chicago is largely due to Mr. Edward J. Hall, vice-president and general manager of the American Telephone and Telegraph Company. Mr. Hall has had immediate charge of the affairs of the company from the beginning. His distinguished ability as an executive officer, and his untiring efforts, have been a striking factor in the progress and completion of this great work.

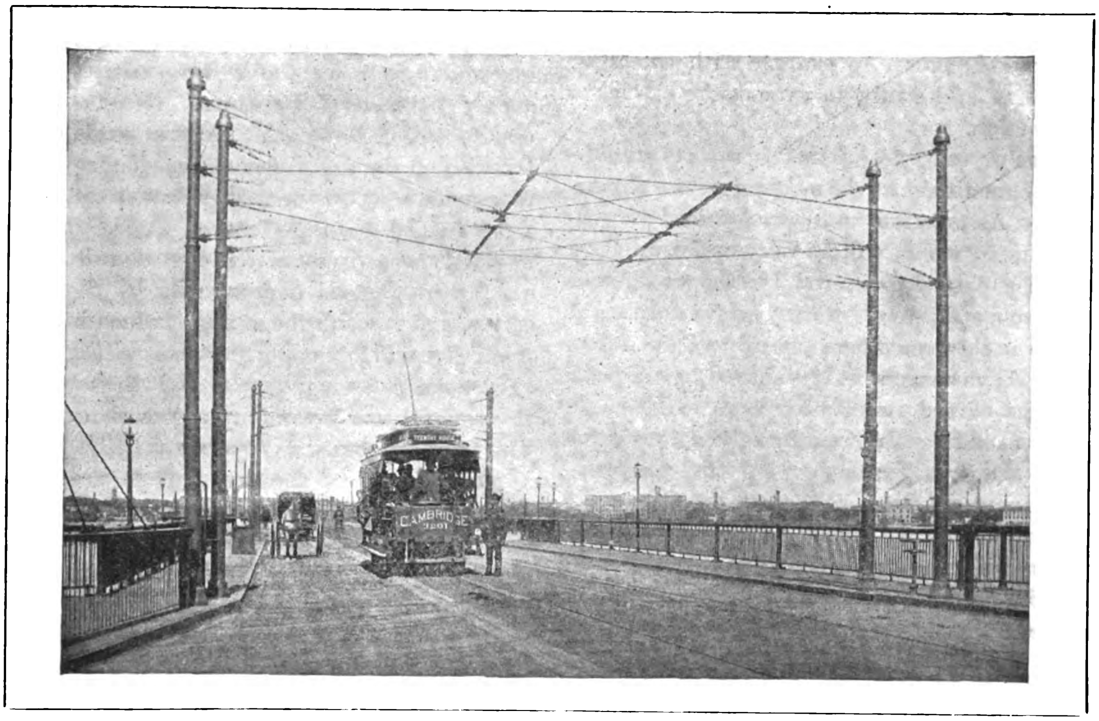
The New Westinghouse Lamp.

THE determination of the Westinghouse Company to supply its customers with incandescent lamps, alleged to be independent of the recently sustained Edison patent, has resulted in the construction of a lamp with a removable stopper as mentioned by us two weeks ago. The adoption of a conical joint in place of the flat joint, early applied in the art, is no doubt the secret of its success.

ELECTRIC RAILWAY DEPARTMENT.

OVERHEAD LINE CONSTRUCTION ON HARVARD BRIDGE.

ALTHOUGH the tracks for the electric cars have been laid on the new Harvard Bridge over the Charles River, at Boston, for nearly a year, the electric equipment has been delayed by litigation until very recently. Once started, however, the work has been rapidly pushed to completion and presents to-day an appearance that is probably unsurpassed by any piece of overhead construction in the world.



OVERHEAD LINE CONSTRUCTION ON HARVARD BRIDGE, BOSTON.

A point of especial interest is the method adopted to obtain a practically continuous wire over the draw. It is strong and thoroughly efficient, and, at the same time, neat and unobtrusive in appearance and very light in weight. As will be seen from the accompanying illustration the arrangement is such that the trolley wheel travels from the end of a pointed terminal onto a flat, pan-shaped plate, the former being suspended several inches directly below the latter. As the wheel runs under the pointed terminal it presses it up until the flanges come in contact with the flat plate, thus making a mechanical connection and forming a continuous line. The wire is thus ready for the car to pass the instant the draw is closed.

The character of this piece of work is highly creditable to the West End Street Railway Company, of Boston, and it is hoped that the result will inspire other companies throughout the country to equal efforts in the same direction.

AN IMPORTANT ELECTRIC RAILWAY PROJECT IN NEW JERSEY.

ARTICLES of incorporation have been filed for a new street railway to begin at Morris avenue, Elizabeth, and run through to Orchard street, to Westfield avenue, to Grove street, to West Grand street, to Jersey avenue, thence through Third avenue in Linden township to Walnut street, in Roselle, and be continued through Cranford township to the Central railroad depot at Westfield. The road will be operated by electricity. The capital stock is $100,000. It will be known as the Elizabeth and Plainfield Street Railway Company. The incorporators are Supt. W. H. Peddie, of the Central Railroad; J. B. McGiffert, superintendent Suburban Electric Light Company; J. H. Vail, chief engineer Edison Electric Light Company; H. P. Baldwin, general passenger agent Central Railroad; James Garwood, of the Garwood Land Improvement Company; Foster M. Voorhees, Luther M. Whitaker, of Westfield; Dwight F. Barrett, of Cranford. The road will be seven miles long and in time will be extended to Plainfield. Applications are to be made at once to the authorities of the various municipalities which the proposed road is to traverse.

THE SHORT GEARLESS MOTOR.

IT seems somewhat strange, even in this day of rapid progress, that the gearless motor, so familiar to electric railway men, was scarcely thought of a year and a half ago. The first example of this type was a four-pole machine flexibly mounted upon the car axle and having the magnets presented to the sides of the armature. It was rather too heavy in its construction, and 36-inch wheels upon the truck were necessary. This was afterward modified by mounting the armature on a hollow shaft connected with the axle by means of a flexible driving device. The next

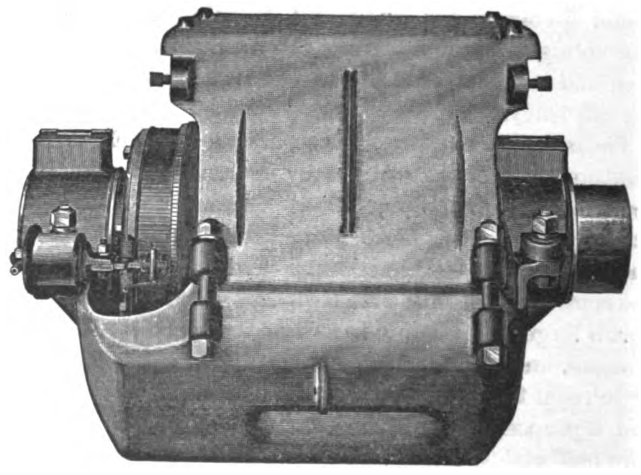


FIG. 1.—THE NEW SHORT GEARLESS MOTOR.

improvement consisted in presenting the pole-pieces to the face of the armature, instead of the sides, and also in modifying its form, widening the face and diminishing the diameter so that 33-inch wheels could be used.

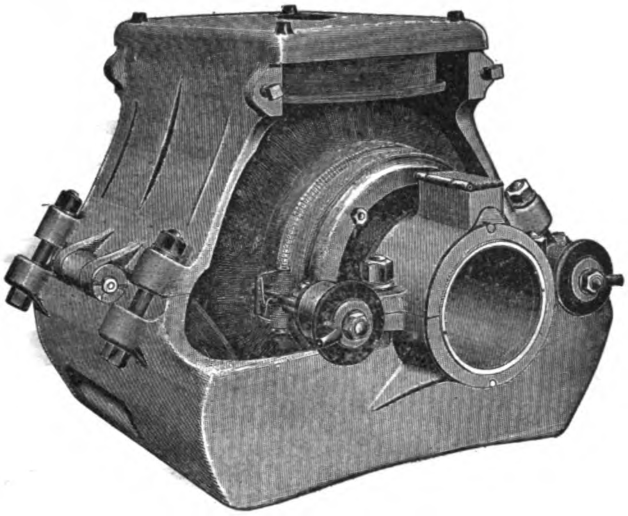


FIG. 2.—THE NEW SHORT GEARLESS MOTOR.

Not content with their success, the Short Electric Railway Company have now perfected another type of gearless motor, embodying important improvements, two views of which are shown in the accompanying illustrations. This motor, which was shown at the Street Railway Convention in Cleveland, is a six-pole machine, weighing, complete, 2,300 pounds. The frame is cast from steel in two sections; the upper half is supported by the truck; the lower half is hinged to the upper, and may be swung down when a car is over a pit, so that inspection is rendered easy. The lower half of the frame is cast without any opening up to the level of the centre of the axle, so that the motor may run through water and slush without any possibility of their penetrating inside the frame. Practically, therefore, the machine may be considered a waterproof motor. The armature is twenty-one inches in diameter, and, as in previous types, is mounted on a six-inch hollow shaft through which passes a four-inch axle. To the end of the armature shaft is a flexible driving device for connection with the car axle.

The diameter of the armature is sufficiently decreased in the new type, so that 30-inch wheels may be used with a clearance of three inches between the bottom of the motor frame and the track. The six poles are presented to the face of the armature. The latter is built with 92 bobbins, with 16 turns of wire on each, which are connected to 184 commutator bars. The armature is designed to run at 120 revolutions per minute when developing 20 h. p. Two of these motors will exert a horizontal effort of 1,500 lbs. in starting a car with eighty amperes, and with from 18 to 20 amperes will propel an ordinary car at a speed of about 20 miles an hour.

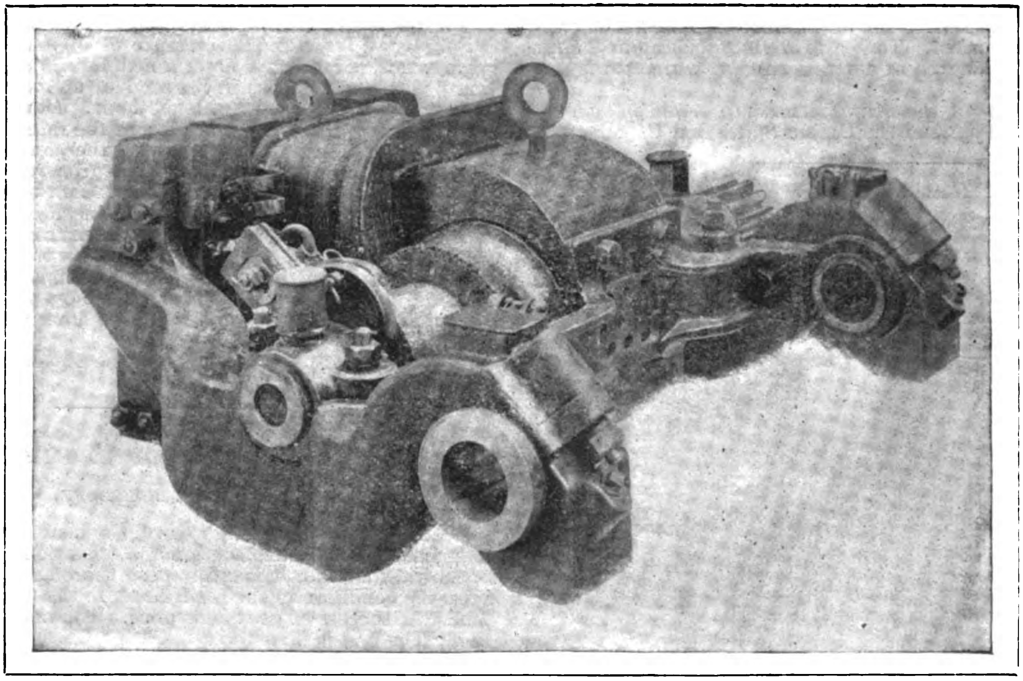
THE "S. R. F." 30 RAILWAY MOTOR.

THE many advantages of the single-reduction motor for electric railway service have, during the past year, been so emphatically proven that the General Electric Company has re-designed its old double-reduction F. 30 motor, making it a single-reduction machine and designating it as the "S. R. F. 30 Railway Motor." In compliance with the demand, already apparent, for the conversion of F. 30 motors, the company is now rebuilding, for many of its customers, a considerable number of these machines.

In effecting the change, the side arms, nose plate, intermediate shaft pinion and gear of the old F. 30 motor have been discarded and replaced by newly designed side arms which support the motor proper. As will be seen from the illustration, they occupy a position exactly the reverse of that in the F. 30. The nose plate becomes a support to the pole-pieces, and the pinion and gear are similar to those used on the General Electric Company's W. P. railway motor.

By doubling the turns or convolutions in the armature winding, and leaving the field spools unchanged, two very important improvements have been secured—the armature speed is reduced one-half, and the strength of the torque of the motor doubled. An improvement has been effected in the arrangement of the armature bearings, facilitating lubrication. The axle and armature bearings are now similar and the same kind of grease can be used on both.

The efficiency of the new S. R. F. 30, when compared with that of the F. 30, shows a decided increase in favor of the new type, although its speed under similar condition of strength of fields is slightly less. The amount of heat developed after a run under full load is also considerably less than in the F. 30. The satisfactory results of the trial tests of S. the R. F. motor tend to show that the transformation of the F. 30 from a double-reduction to a single reduction motor will be satisfactory wherever effected.

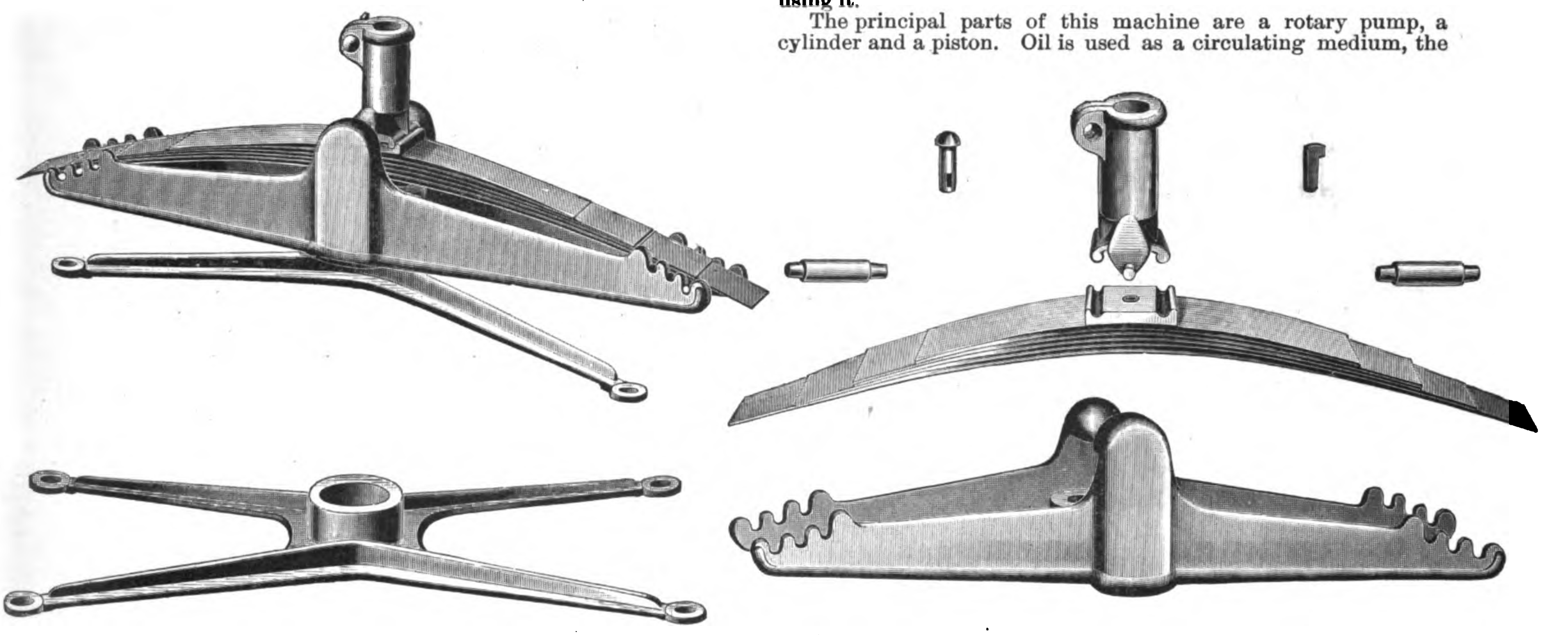


THE "S. R. F." 30 RAILWAY MOTOR.

THE LOWELL ELECTRIC RAILWAY.—With reference to the article in the last issue of THE ELECTRICAL ENGINEER on the Lowell and Suburban Street Railway Co., it should be stated that the whole system—plant, specifications for engines, piping, boilers, etc. —were under the supervision and direction of Col. L. R. Greene, of Boston.

THE PHILADELPHIA TROLLEY.

THE Philadelphia trolley, manufactured by the Technic Electrical Works, of Philadelphia, and shown in the accompanying illustrations, was designed with a view to embodying substantial mechanism with lightness and durability of parts. As will be seen it is composed of but nine pieces, among which there is not a nut, bolt, screw or washer. There are no chains nor coil springs, no wrench is needed for assembling or dismantling and no lubrication is required. The parts are interlocking and interchangeable and the degree of tension can be varied through a wide range.

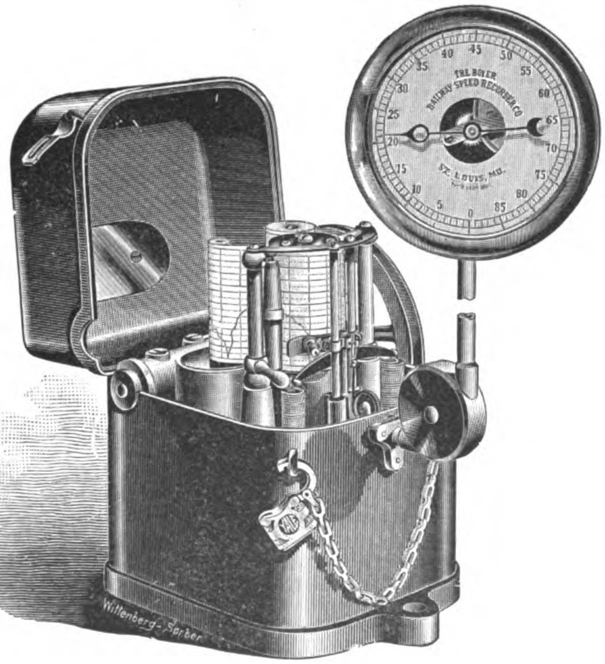


THE PHILADELPHIA TROLLEY.

It is the intention of the manufacturers to establish agencies for this trolley in all parts of the United States and Canada.

THE BOYER RAILWAY SPEED RECORDER.

THIS instrument, shown in the accompanying illustration, is designed to meet the demand of railway officials for an accurate speed recorder and indicator, that can readily be applied to street railway cars, and not only record on paper, but indicate on a dial similar to steam gauge, the speed in miles per hour. When the recorder is attached to a locomotive, the indicator is placed in the cab so that the engineer can see at a glance the actual speed he is running at, as easily as he can see by the steam gauge how much steam he is carrying. When attached to a car, the indicator is placed anywhere to suit the convenience of the parties using it.



THE BOYER RAILWAY SPEED RECORDER CO.
ST. LOUIS, MO.
Wittenberg-Gerber

BOYER RAILWAY SPEED RECORDER.

The principal parts of this machine are a rotary pump, a cylinder and a piston. Oil is used as a circulating medium, the pump chambers and cylinder being entirely filled. While the machine is at rest, the piston to which the gauge wire and pencil are attached, is retained in its lowest position by two coil springs, but when given motion the pump produces a pressure of oil beneath the piston, causing it to rise to a point where an equilibrium is established between the pressure of oil and the tension of the spring, this point being determined by the speed at which the pump is moved; each thirty-second of an inch rise of the piston indicating a speed of one mile per hour. Moving around a drum in the upper part of the machine, at the rate of one-half inch to the mile, is a ribbon of paper, having thereon horizontal and perpendicular lines, each horizontal line from the base or zero line representing five miles per hour, and each perpendicular line, a mile post along the road. A line is traced on this paper with a metallic pencil, showing, by its distance from the base line, the exact speed at which the train passes any point on the road, the number and location of stops, the distance traveled, and the location and speed of any backward movement that may have been made. It records and indicates from 0 up to 90 miles per hour.

The device is manufactured by the Boyer Railway Speed Recorder Company, St. Louis, Mo.

A MODEL ELECTRIC STREET RAILWAY ROADBED AND UNDERGROUND WIRING.[1]

BY G. W. BAUMHOFF.

THIS subject, embracing one of the most important questions connected with the construction and operation of a street railway, is one that should have the most thorough consideration, for, upon the condition of the roadbed more than any other item, depends the success of your enterprise. The motto should therefore be: "The best is none too good."

Your committee has decided, in submitting this report, to dwell chiefly on the merits of various types of rail known as the girder system, and in order to place the same before you in an intelligent manner will proceed with an itemized report in the order in which the construction is proceeded with.

First.—SURVEY. Having decided on the style and weight of rail to be used, and the chairs, fastenings and joints, the first step, in order, is to properly survey the route, if a new road; to estimate the quantity of cut and fill where grading is necessary, and the most advantageous manner in which to provide for the same; and to locate all curves, switches and turnouts. In doing so, care should be exercised to provide for all curves the longest possible radius at points entering and leaving the same, and to provide for the proper elevation of the outer rail of all curves, which should be elevated from one inch to two inches higher than the inner rail, where the condition of the street will permit; particularly in any curve of short radius, and more especially when such curve is located on a down grade.

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[1] Abstract of a report presented at the meeting of the American Street Railway Association, Cleveland, Ohio, Oct. 19-21.

The switches, or cross-overs, should be located at such points along the route as will best provide for the following contingencies: Bunching cars for large gatherings, and to insure the constant operation of cars during fires, parades and all other blockades, when from any cause, the terminus of the road cannot be reached. They should never be placed with the switch point against the traffic; and preferably, on up grades, thus enabling cars to cross to the opposite track by gravity.

Second.—EXCAVATION. The depth of excavation must be determined by the thickness of the cross-tie, height of rail, and height of chair, if chairs are used, plus the space allowed for tamping. The condition of the soil must govern the latter exclusively, but in the reconstruction of the roadbed, where the operation of of cars will permit, and in all new work, unless the soil is of a sandy character, the following plan will not only provide a suitable sub-drainage, but insure permanency: Remove all earth to a depth of 8 inches below the bottom of the cross-tie the full width of the trench; then roll thoroughly with a heavy four-horse ro steam roller; then spread with a layer of cinders, crushed rock, gravel or furnace slag, from 6 to 8 inches in thickness, and again roll until the same is well bedded and leveled. A trench 7 feet in width, with a layer of 8 inches, will require for one mile in length 24,640 cubic feet of material, estimated at 3½ cents = $862.40, and will require the removal of 912 yards of earth, estimated at 25 cents = $228; add for rolling, $50. Total, $1,140 per mile of singe track.

Third.—CROSS-TIES. Under this heading we have the metallic tie and various kinds of wood. The committee's remarks will be confined to the latter exclusively. The size should never be less than 5 x 8 inches for rail 56 pounds and over, and if laid as closely as good tamping will permit—say 27 inches from centres—will materially strengthen the roadbed and assist in holding up the joints. For joints where wide joint chairs are adopted, one tie of sufficient width is preferable, as it is impossible to insure good tamping where two small ties are used at the joints. If the above size is decreased, it should be in thickness rather than in width, to insure the tie from splitting, which is often caused by the spike being driven too close to the edge. The committee recommend the white-oak tie.

Fourth.—RAIL. In the selection of the rail depends largely the success of perfect construction; and a road, whether built for speculative purposes or as a permanent investment by the projectors, should not be slighted in this respect. The requirements of a rail for electric traction are strength, joint connections, durability. In some localities there are municipal requirements specifying what the head of the rail shall be. For strength we rely chiefly on the weight of the rail, and the thickness and depth of the web. For joint connections, that rail which affords the best method of keeping both ends of the rail in perfect alignment is the best, and as the girder rail possesses peculiar advantages in this respect, its almost universal adoption is due to that fact. For durability, we depend on the height of the head of the rail at the gauge line over the lower flange, and the quality of the metal.

The report then gives the result obtained on rails by Dr. C. B. Dudley, chemist of the Pennsylvania Railroad and the specification for steel rails.

The subject relative to the quantity of the various elements entering into the manufacture of steel, which shall produce the rail calculated to give the most wear, and yet avoid brittleness, is one in which there is a great divergence of opinion. The rail over which electric motors are operated through thoroughfares in various cities throughout the country is certainly subject to as much wear as, if not more than, that of many of the trunk lines; and as we have patterned closely after their method of construction, we may perhaps profit by following their example in other details.

Of the various forms of the head, the centre-bearing rail is the most desirable, because, with a lower tram on each side, the head is kept free from dirt, and consequently offers less resistance to the car wheels.

Next to the centre-bearing form of head, the side-bearing head is by far the most desirable, from the operator's standpoint; for the only other form made, of the girder type, is that with a groove, instead of a lower flange. The latter form of head is suitable only for curves and cross-overs, when rolled with a wide groove, and should never be adopted for straight track, owing to the tendency of the groove to hold dirt, snow and ice.

In the selection of a girder rail of any form of head, and more particularly the style known as side bearing, it would be well to remember that the rail having the widest base offers the greatest resistance to turn over; and care should therefore be exercised in the selection of the rail, to secure the widest possible foot, and your committee would urgently advise enlarging the rolls at the base of the rail, in order that the same shall at least equal in width the combined width of the tread and lower flange.

Fifth.—CHAIRS. If chairs are required, care should be exercised in selecting such as will insure the greatest possible bearing on the tie, and such only as will not spring under heavy loads. A chair with a narrow base is apt to cut into the cross-tie, and in time work loose or cause the rail to cant. All intermediate chairs should be provided with a brace extending well up under the outer head of rail, which is the best safeguard against the rail turning or canting.

Sixth.—JOINT SUPPORTS. Your committee would very urgently recommend the adoption only of such joint-supports as are of sufficient length to cover at least two ties, but consider such as secure a bearing on three ties preferable. The holes in the web of the rail should be not less than one inch in diameter, to admit the use of a bolt having a large size nut, which should be tightly secured by the use of a hammer and wrench. A six-hole fish-plate of sufficient height to reach from the foot of the rail to the bottom of the head, 26 inches or over in length, securely fastened with large size bolts, is considered by many who have used the same to be superior to all other joint fastenings.

We must bear in mind that cars, as now operated by electricity, are not only heavier than horse cars, but are operated at a much higher rate of speed, and require the most thorough construction. The slightest spring, or looseness, will gradually result in a low joint, which if not soon attended to, will ruin the end of the rail beyond repair. It would, therefore, be well to relieve the fish-plate of much of this strain, by providing a support for the bottom of the rail extending over two or more cross-ties.

There exists among railway managers a difference of opinion as to the choice between a supported or suspended joint. Your committee, however, earnestly recommends the supported joint, with a support for the bottom of the rail extending to the adjacent ties, and does not deem it advisable to adopt the suspended joint construction, unless the joint support has a firm bearing on the adjacent ties. There are a number of such joint chairs of various manufacture now in use, which your committee are reliably informed are giving entire satisfaction.

There is also a diversity of opinion as to the location of rail-joints with respect to each other, and on this subject we do not hesitate to take a firm stand in support of the joints being laid directly opposite each other, when constructed for electric traction, as the tendency where laid with broken joints is to cause the car to sway sideways, particularly at a high rate of speed, if the joints are not kept extremely perfect. The former plan renders it also more economical to repair joints, especially in paved streets.

Seventh.—PAVING. Of the various kinds of paving now in use, the following are chiefly adopted, and about in the order in which they are named: Granite, telford, asphaltum, wood and brick. The former being by far the most durable, most cheaply maintained, and less expensive to remove and replace, for the necessary track repairs, justifies the adoption of the same over that of asphaltum, wood or brick, and warrants the additional first cost, which accounts for its almost general adoption by street railway companies where paving is required, and by municipal authorities on streets where railway tracks exist, or are contemplated. In some localities asphaltum paving is adopted on streets where railway tracks are laid; but owing to the tendency of vehicular traffic to wear ruts alongside of the rail and the spring of the rail to loosen the paving material, together with the increased cost of repairing the same, it is not as favorably considered, for track paving, as some of the other systems.

To overcome the first-named objection in some locatities where this paving is adopted, a double row of granite blocks is laid, adjoining the rail, which also provides for the vibration of the rail and renders it more accessible to get at the foundation of the roadbed for necessary repairs.

Telford paving is not suitable for thoroughfares subjected to heavy vehicular traffic, and should only be adopted for street railway tracks on suburban divisions, where, owing to its cheapness, it is quite extensively adopted.

Brick in any form, made of clay or other material, has thus far not stood the test of vehicular traffic to warrant its adoption in any climate, either by railway companies or municipalities, and should, therefore, be given a most thorough trial before it is extensively used.

With girder rail construction, it is advisable to fill in the web of the rail with moist clay just before paving, in order to prevent the paving blocks from working loose, caused by the sand surrounding the same filling up the space, thus leaving the blocks unprotected, and tending to cause the row of blocks adjacent to the track to settle unevenly. In some localities an iron frame is constructed at each joint for the purpose of providing for repairs to the same, without disturbing the paving, but with the latest girder rail joint construction, ties well tamped and bolts securely fastened, the necessity for such construction does not exist.

Eighth.—UNDERGROUND WIRING. A large-size insulated copper wire is generally adopted to form the connection between the generators and such points along the track as it is deemed advisable to reach. The return circuit may be completed, either by connecting said wire to the rail, or to a supplementary wire extending the entire distance of the track. The latter is in all cases recommended, and should invariably be soft copper wire, not smaller in size than No. 0. In either event, however, all rail joints should be bonded with a soft copper wire not less in size than No. 6, and if the supplementary wire is laid, a connection thereto should be made to at least every fifth rail; and it will also be of great advantage as a safeguard against any possible break in the circuit, to connect both sides of the track with a No. 6 wire, and if a double track, to cross to the opposite track, and to the supplementary wire in said track, at least every thousand feet.

After a thorough trial of upwards of three years, during which time we have used both, the conclusion reached is, that copper being not only a better conductor than iron or steel, but less liable to corrode and break, is therefore the best wire to use for underground work. Galvanized soft steel or iron wire used for this purpose, has not proved durable, and we have found the same to be entirely eaten away by electrolysis where it had come in contact with the cross-tie, and in perfect condition elsewhere.

The only theory we can advance for this is, that a chemical action takes place between the gases of the earth, precipitated by the sap contained in the timber and salt water—the latter from the use of salt for the purpose of melting snow and ice—although such results have not been noticeable in the use of copper wire. In addition to cross-wiring, as above mentioned, as a precautionary matter, to insure a complete circuit, it will be found advantageous to the economical operation of an electrical railway, to excavate or bore in the earth, to a sufficient depth, to secure continual moisture, and whilst iron is usually adopted, owing to its cheapness, yet we believe the use of copper will, in time, prove the most economical metal to adopt for this purpose. Where such grounds are located, care should be taken to make the best possible connection to the supplementary wire and the track.

By a careful examination of the amperemeter at the power house, during dry weather, compared with that of rainy weather, it will be noticed that there is a marked decrease in the amount of current used, in favor of the latter; hence, it follows that the more connections to the rail and the opposite poles of the generator, with the most earth, the more economically is the system operated. It must also be remembered that the increased saving in current in wet weather, over that of dry weather, is not attributable to the increased moisture of the earth alone, but to the fact that the dust and dirt, which readily finds lodgment on the rail, is washed off, and many roads now in operation by electricity have found the use of a car equipped with a tank having one down-spout, about ⅝ inch in diameter, on each side, so arranged as to permit a stream to flow over the head of each rail, most advantageous. These down-spouts should be located as near the wheel as possible, in order to insure their being directly over the rail at all curves, as well as the straight track.

In conclusion, we have only to say, as to the construction of "A Model Electric Street Railway Roadbed and Underground Wiring," its successful accomplishment will involve the comparison and investigation of a wide range of personal experiences, coupled with the patient study of those engaged in the manufacture of rail and track supplies, who are constantly endeavoring at great expense to improve the material and method of construction.

STANDARDS FOR ELECTRIC STREET RAILWAYS.[1]

BY O. T. CROSBY.

THE committee as first determined consisted of the following members: O. T. Crosby, chairman; H. I. Bettis, who gave special attention to the matter of accounts; E. E. Higgins; Chas. W. Wason, named as mechanical member, and R. W. Rippetoe. The last-named gentleman resigned from the committee work shortly after its inception, and Mr. J. E. Rugg, of Pittsburgh, was appointed in his stead.

The thing on which definite recommendations were to be made to the Association was as follows:

1. Accounting methods. Concerning this the object of the committee will be to emphasize the three headings—transportation, maintenance and construction, under which expenditures are to be kept.

It was also concluded to present the car mile as the unit of operating expenses, especially in regard to the item of motive power. For the purpose of comparing motive power expenditures double-truck cars shall be distinguished from single-truck cars, while double truck cars shall be classed with trains of two cars.

Methods of Accounting.—While awaiting any further special treatment of the subject from Mr. Bettis, I beg to call special attention to the recommendation that a car mile be adopted as the unit of operation in regard to the item of motive power. The introduction of the double-truck cars into street railway service makes this unit, however, somewhat inaccurate unless the distinction between the various kinds of cars be carried along with the use of this term. We have thought that the distinction should rest rather as between double-truck cars and single-truck cars than between cars of different specified lengths. Furthermore, and especially relating to the question of motive power, we recommend that it will be reasonably safe to class two standard 16-foot cars with double-truck cars, experience having shown that the consumption of power in the two cases is nearly equal under given conditions as to track, grade, etc.

One of the chief difficulties heretofore standing in the way of determining accurately the cost of one mile of service has been the inaccuracy in the determination of the amount of power consumed for such unit service. The perfection of recording wattmeters that has taken place during the past year will go far towards remedying this difficulty. We do not feel it necessary to enlarge upon the importance of careful bookkeeping looking to the determination of these three headings. We assume that all intelligent railway men appreciate the importance of knowing what they are doing.

Standardizing of Specific Dimensions.—In regard to this heading I take pleasure in inserting herewith the report of Mr. C. W. Wason, sub-committee on this subject.

"In order to better determine the sizes of the several parts given me, as a member of the standardizing committee, I sent out circular letters to two hundred of the leading electric roads, requesting them to give their opinion as to the sizes of the several dimensions. "I would state right here that from the small number returned, namely, about thirty out of two hundred, that the street railroad companies do not realize the benefit to be derived from such a movement, else they would take the trouble of answering such questions of general information, thus enabling the committee to much better arrive at a satisfactory conclusion.

"In order to obtain the dimensions of the car journals, such as this committee may think best to recommend, I corresponded with the several truck manufacturers, who kindly gave me blue prints and drawings of their journal boxes. If the electrical manufacturers continue to increase the weight of their motors, these dimensions should be increased. The data I here present has been gathered from railroads, using possibly a lighter equipment than which is now being put upon the market. It is absolutely impossible to standardize an appropriate size, considering the change of weight, but the following seems to be the best in the opinion of those from whom I had answers to my inquiries:

Diameter of axle 3¼ inches.
Diameter of car axle journal 3 inches.
Diameter of axle wheel seat 3½ inches.
Length of car axle journal 8¼ inches.
Diameter of car wheel 33 inches.
Weight of car wheel 350 pounds.
Diameter of trolley wheel 4¼ inches.
Width of trolley wheel 1¼ inches.
Depth of groove in trolley wheel when new 1¼ inches.
Size of key way for axle gear ¼ inch by 6 inches.
Distance between hubs of wheels measured along the axle 48 inches.

It is essential that the groove and depth of trolley wheel be the same if the cars run over the same style of switches, as it is almost impossible to put up an overhead construction that will carry all sorts of trolley wheels. This remark may at first look a little absurd, but when one has had much experience with several different size trolley wheels he will at once appreciate the necessity of all being alike."

The diminsions above recommended as standard have been approved by the other members of the commitee to whom they have been submitted, except that Mr. Rugg prefers a 30-inch wheel instead of a 33 inch to be considered as standard. We have endeavored not to forget the principle referred to in the papers presented last year, namely: "That the standardization of parts should be so directed as not to interfere with the progress of invention." The dimensions of wheels and trolleys above given are intended to be applicable alike to single-truck and double-truck cars.

A large majority of the numerous persons addressed upon the subject, recommended No. 0 B. & S. gauge as the best size for standard trolley wire. It is further understood that such trolley wire shall be of hard drawn copper; its conductivity to be 98 per cent. of the standard in the usual tables used; its tensile strength close to 55,000 pounds per square inch.

Nomenclature.—The list of names suggested by the writer in the paper last year has been submitted to a number of railway officials, railway contractors and manufacturers of electrical goods. Some corrections of the list as presented last year have been recommended by various persons and are herewith incorporated. The name now recommended appears first, and after it in parenthesis is the one heretofore used for some articles.

Nomenclature of Electric Railway Terms.

Generator—(Generator, dynamo)—Machine in which the electric current is generated.

Motor—(Motor)—Machine in which the electric current is transformed into mechanical power.

Frame—(Frame) - Iron body of machine, including pole-pieces and standards or side arms, if any, but not including base plates and bearings.

Standards—(Standard bracket)—Supports of the bearings of generator.

Side Arms—(Side arms, check pieces, armature bracket)—Supports of bearings of railway motors.

Pole-Pieces—(Pole-pieces)—That part of the frame from whose surface lines of force may pass directly to the armature.

Field Coil—(Field coil, spool)—Coils of wires wound on frame in such a way that a current passing through these coils makes magnets of the frame and pole-pieces.

Brush Holder—Device for holding the brushes in contact with the commutator, including the insulation used in its support.

Rocker Arm—(Yoke, rocker arm)—Device for holding brush holders in position on commutator while attaching it directly or indirectly to the frame.

Fuse—(Fuse, fusible plug)—A metal device for opening circuit when the current becomes abnormally large, the soft metal being melted by a current of fixed quantity.

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[1] Abstract of the Report of a Committee of the American Street Railway Association, submitted at the Cleveland meeting, Oct. 19-21.

Switch—A device for closing or opening a circuit at one or more points.

Rheostat—(Resistance box, rheostat)—Wire or other material suitably protected and conveniently arranged to be introduced in more or less proportion into a circuit.

Trolley—(Trolley contact bar)—A device used to transmit the electric current from the overhead wire to the cars, consisting usually of a

Trolley Wheel—A small metal wheel making rolling contact with the overhead wire.

Trolley Fork—Mechanically connecting trolley wheel to

Trolley Pole—Supporting the trolley fork and wheel and resting in a socket, which is part of the

Trolley Base Frame.

Trolley Wire—Wire from which the trolley wheel directly receives current.

Standard Trolley Switch—(Trolley frog, frog, overhead switch)—A device used to fasten or hold together the trolley wires at a point where the trolley wire branches, and to guide ordinarily automatically, the trolley wheel along the wire over the track taken by the car.

Trolley Switch—A switch designed for use at a point where two branch lines make equal convergent angles with the main line.

Right Hand Trolley Switch—A trolley switch designed for use at a point where a branch trolley wire leaves the main line to the right in the going direction.

Left Hand Trolley Switch—A trolley switch designed for use at a point where a branch trolley wire leaves the main line to the left in the going direction.

Three-way Trolley Switch—A trolley switch for use at a point where the line branches in three directions.

Drawbridge Crossover—A device permitting the easy passage of a trolley wheel from one to the other of two adjacent wires in a continuous direction.

Trolley Frog—(Trolley crossing, crossing frog, crossover)—A device placed at the crossing of two trolley wires, by which the trolley wheel running on one wire may cross the other, the device also holding the two trolley wires together.

Insulated Trolley Frog—(Insulated trolley crossing)—A device placed at the crossing of two trolley wires, by which the two wires are insulated from each other, and by which the trolley wheel running on one line may cross the other.

Hanger—(Line insulator, line suspension, trolley insulator)—A device for supporting and insulating the trolley wire.

Straight Line Hanger—The hanger used on a straight line and supported from a span wire, the strain on same being essentially vertical.

Single Curve Pull Off—(Single curve hanger)—The hanger supported by a lateral strain in one direction and, ordinarily, on single track curves, except at ends and the inside curve of double track.

Double Curve Pull Off—(Double curve hanger)—The hanger supported by a lateral strain in opposite directions, used ordinarily at ends of both single and double curves and at intermediate points and on double-track curves.

Feeder Clip—(Feeder clamp)—Clamp with a device by which a feed wire may be connected to the trolley wire.

Feeder—A wire usually insulated, used for transmitting current from the power station to the mains or the trolley wire descent.

Mains—Wire usually insulated, serving for the distributing of current from the feeders to the trolley wire through tap wires.

Tap Wires—Wires to convey current from feeders or mains at the pole to a near point of the trolley wire.

Trolley Wire Section—(Trolley section)—A length of one trolley wire with or without branches, but continues electrically.

Line Section—A part of the overhead conducting system, so insulated from other parts as to permit the supply of power to be separately controlled.

Section Box—A box containing section switches and fuses used for control of a trolley section or line section.

Rating of Motors.—I quote from the paper referred to as follows: It must be borne in mind that an electric motor, like any other machine, a man, for instance, is capable of performing work at widely-varying rates and widely-varying efficiencies, and with widely-varying factors of safety with respect to indefinite continuance of such a rate of work. It should further be borne in mind that an electric motor in particular is known to do its maximum rate of work when its efficiency is only 50 per cent.; that is, if 20 h. p. represents the maximum rate of work, then 40 electric h. p. will be required to perform this work.

The first condition, which should be connected by implication with any rating whatever, is this: That the machine in question shall be able to perform its rated work indefinitely and under any condition of atmospheric temperature. There is, of course, room for honest differences of opinion in regard to this point. There is again room for honest differences of opinion in regard to the efficiency with which a motor can do its rated work.

In spite of the fact that many objections may be urged against any suggested method of rating, that which is preferred by your committee and by many persons consulted in regard to the question is this: That a motor shall be known as to its capacity by the horizontal effort which it can apply to a car at a speed of 10 miles per hour, the standard 33-inch wheels above recommended being used on the car, and whatever gearing may be preferred by the manufacturer. It is plain that the horizontal effort that may thus be produced from a given motor whose armature is running at a given speed, may be made to vary by this change of gearing, but it has been thought best to consider the motor and its gearing as one piece of mechanism. While this recommendation would at first involve the use of two terms in the name of a motor, namely, horizontal effort and speed, the term for speed would soon disappear after it has become generally understood to be 10 miles per hour. Thus for the present, calling a given motor 600 x 10; this meaning that at a speed of 10 miles per hour the motor in question will develop a horizontal effort of 600 pounds. Later, however, the same machine would be satisfactorily designated as a 600-pound motor, the standard speed being taken for granted. At the same time as street railway men begin to go into sububan enterprises, in which higher speeds than those now familiar must be attempted, it will be easy to revive the expression for the speed at which a motor is rated, and we may thus expect to see motors described as 600 x 20, 600 x 30, etc. This high speed extension of electrical motor work, and especially its extension in the same hands as those now directing ordinary street traffic, makes it especially important that some rating should be adopted which will take speed into account, as otherwise confusion will inevitably result. It goes without saying that much remains to be told concerning a motor after its horizontal effort at a given speed shall be expressed, and a part of the recommendation of your committee is that an implied part of the rating of a motor lies in this, that it shall be able to perform its rated work continuously without a rise of temperature exceeding 75 degrees C. over the atmospheric temperature.

In regard to the efficiency, desirable as it is to be informed on that point, it seems too difficult to be involved in any rating which shall be frequently and properly used.

Another method of rating motors which is presented as the second choice of your committee is as follows: That two terms should be used, one giving the horse-power of the motor at which it can work continuously at a safe temperature, the other its maximum horse power. As has been explained, it is a feature of all electric motors that their maximum rate of work is done at a 50 per cent efficiency. Nothing is more essential to be established, therefore, than the maximum work the motor will do. Following this method which was suggested by Mr. Chas. A. Lieb, a given motor might be known as 15 x 35 or as 20 x 40, etc., concerning the first machine named, it being understood that it could do 15 h. p. of work all day long without undue heating, but under stress it could peform work at the rate of 35 h. p., the efficiency being at once known to be down to 50 per cent. It would also be understood, and go almost without saying, that the motor would be unable to do 35 h. p. of work continuously; indeed it would be expected to perform such a rate of work safely for only a very short time, say from two to five minutes.

In conclusion, while urging that all definite action possible shall be taken on the recommendations now made, we further urge most strongly that steps be taken to carry on permanently the work of standardizing, especially the work of standardizing the nomenclature and dimensions, since in regard to these there can never be any cessation of demand. To further this object we recommend that this Association employ a salaried official to be known as the statistical secretary or clerk; and that such employee shall give his whole time to the obtainment of data bearing on the work of the Association.

STANDARDIZING OF ACCOUNTS—ACCOUNTING METHODS AND STATISTICS.[1]

BY H. I. BETTIS.

THE ultimate object of all accounting is to ascertain with accuracy the amount of net income after all operating expenses and fixed charges have been paid. With this object in view, and no other, the art would be reduced to a very simple profit and loss account, debited with all expenses and credited with the entire income; but the owners and managers of our street railway properties for many reasons desire some further information than this. It is not sufficient for them to know that their road has a certain income, or that the expense has reached a certain amount. They desire to know many things in addition to these: What was the source of income; how many miles of track they have; how many cars; how many trips those cars make; how many passengers they carry. What other sources of income were there; what was the expense of operating the road; what portion was simply for the transportation of the passengers; how much was paid for motive power; for repair of cars; of apparatus; of track; buildings, etc., etc.; has anything been expended in construction, improvements or betterments.

Having all this information well in hand, the owners and managers can determine more readily wherein the expenses have been too large, and have thereafter a basis upon which to calculate their future operations. Moreover, what is of incalculable benefit, they can compare the cost of operating expenses of other lines throughout the country.

In the case of the steam roads of the United States the Interstate Commerce Commission has caused to be compiled a *Classification of Expenditures* and certain rules for their guidance in making the annual reports to the Government. Most of the railroad commissions of the several States have adopted this classification, and nearly all the railroad companies use the same in their accounts. It is quite probable that in the near future the Interstate Commission may extend its jurisdiction over the street railway companies, and in that case would compel them to adopt a uniform system of accounting as a basis.

This committee will not attempt to prescribe a set of rules and reports, but only to suggest certain distinctive lines which we believe should be followed in the future, when deciding upon a basis for accounting statistics.

Division of Expenses.—We are all agreed that it is essential for the expenses which add to the present or future value of a property to be separated from those which do not, and that the three great divisions should be: 1, transportation expenses; 2, maintenance; 3, construction. This established, the various subdivisions may be few or carried to infinity, but the final results are necessarily the same.

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[1] Addendum to report of committee on standards.

The differences between these divisions are as follows:

1. *Transportation* expense is simply the expense of transporting the passengers, and includes nothing whatever expended upon the property. Under this heading we should find wages of conductors, drivers, gripmen, motormen (engineers and firemen on dummy lines), fuel, provender, lubricants, wrecking, etc., etc.

2. *Maintenance* expense is the expense of keeping the properties in their original condition, and consists of the amounts expended upon repairs of track, buildings, cars, power plant, engines, etc., etc.

1. *Construction* expense is such as adds to the value of the original plant, such as additional buildings and machinery, new tracks laid, less the value of old ones taken up, etc., etc.

Improvements and betterments should also be included under the head of construction, that is, for such portion as the property is improved over the first cost.

One question deserving your consideration is that of taxes, and whether it should be included in the operating expenses or not. I have noticed that the majority of the roads do now include it, while a few deduct it from the net income after operating expenses.

Material.—Another point we would suggest is to recommend the accounting for material as closely as possible. It is the practice upon many roads to keep no account of material purchased and kept in stock for future use, but to charge all material purchased to expense, whether used at once or not. It must be perfectly clear that when material is purchased, there is no decrease in the assets of the company and consequently no expense. There has been simply an exchange of cash for material. The expense does not occur until the material is used.

It is absurd to charge to the expenses of one month all the bills paid in that month, or the bills contracted in that month, when the material covered by the same may have been used long ago, or may be in stock and for future use. Material used represents from 30 to 40 per cent. of the expenses of operation, and yet on the majority of our roads it receives no attention whatever.

Unit for Comparison.—It has been suggested that we adopt as a unit for comparison *the car mile*, especially in regard to motive power, and consider the single truck with double motor car as the Standard, double-truck cars to be equal to two trains of two cars each. It is difficult to say what should be the unit, whether it should be the car mile, the passenger or neither. When we consider the vastly different conditions to be contended with on the various roads, in the shape of grades, distances from power house, amount of traffic, etc., we can hardly settle upon any factor for a unit. It may be decided that the best results for comparison will be found by comparing the percentage which operation bears to gross income.

Future Work.—I would advise for the continuance of this work that a committee, selected from the accounting officers of roads in this association, be appointed to prepare a standard classification of expenditures, with blanks for statistical reports to be referred to the next annual convention; the same to be previously circulated among the members of the Association, in order to obtain the fullest possible criticism and examination at the convention.

RELATIVE COST OF OPERATION OF HORSE, CABLE AND ELECTRIC ROADS.[1]

THE work which the committee had to perform was to ascertain from leading horse roads, cable roads and electric roads, such information regarding the cost of operation of each, as the existing methods of accounting in each case made possible. They recognized in the early stages of their work that any attempt on their part to shape the accounts of the companies to suit the purpose of the committee would be fruitless, for reasons which must be obvious to all. A series of questions were framed comprehending the information desired, and with such subdivisions of operating expenses, as it was thought would meet with most ready reply. Many of the replies sent to the committee were given for the personal consideration of the committee alone, and not for publication or public reference in any way. We have, however, chosen a few of the representative roads of each class, and have tabulated the replies in such a way that reference can be made to them by number if desired.

A comparison of the reports from these roads does not reveal the characteristics which we should expect to find. We see results which are as varied as could be imagined. Why should cable road No. 1, earning only 18 cents per car mile, have within eight cents per car mile as much to divide among its stockholders as road No. 3, having nearly 12 cents per car mile more receipts? Let us refer to the reports of these two roads and make a few comparisons.

TABLE NO. 1.

Operating Expenses, etc., of Eight Cable Roads.

No.	Average No. of grip cars operated daily.	Average No. of trail cars operated daily.	Daily mileage of grip and trail cars.		Receipts per car mile, including mileage of trail cars.	Fixed charges per car mile.	Interest on funded debt.	Taxes, tolls—State, county and municipal taxes, except water taxes.	Gross operating expenses per car mile, exclusive of fixed charges.	Maintenance of roadbed and track.	Maintenance of cable rope and underground machinery.
			Grip.	Trail.							
1	198	298	80	80	18.054	1.624	1.069	.555	8.810	.401	.686
2	30⅛	...	127	..	18.300	4.700	4.200	.500	13.700	.500	2.300
3	54	...	100	..	29.840	5.440	3.200	2.240	16.000	1.910	1.720
4	6	6	90	90	15.10	... .	.....	.....	41.000	.....	.....
5	7	7	70	70	19.80	.....	.659	1.210	......	.....	.....
6	29	58	104	104	.....	1.230	.900	.....	6.750	.....	.....
7	8	5	90.40	105.65	.....	1.884	1.582	0.352	10.715	.448	.734
8	70	70	123.54	123.54	. ...	6.610	5.700	0.910	20.050	.400	3.000

TABLE NO. 1 (*Continued*).

Operating Expenses, etc., of Eight Cable Roads.

Maintenance of power plant, including repairs to engines, boilers, etc.	Maintenance of plant in general buildings, etc.	Maintenance of rolling stock.	Maintenance of grips, including inspection and shopwork.	Cost of power—fuel, water, oil, waste and wages of employees.	Cost of transportation—conductors and motormen, lighting and heating cars, etc.	General expenses — salaries, legal, accidents, etc.	Net earnings per car mile.	Wages of conductors and gripmen per hour.	Kind of fuel used.	Cost per ton.
.530	.132	.594	.084	.925	4.702	.756	7.620	28c.	Screenings	1.47
.100	.030	.300	.100	1.700	6.400	2.000	4.900	17c.	Slack and nut.	2.02
.190	.580	1.030	.570	1.070	7.450	1.480	8.400	18½c.	Coal.	1.21½
....	..	.. ..	....	.....	7.000	3.000	... .	17½c.	R. O. M.	2.00
...	....	....	....	.....	.....	.....	.....	.....	....	..
....	....	....	....	.....	.....	.....	.....	19½ and 20½	....	....
055	....	.480	.263	2.530	4.984	1.221	.....	22½c.	Petroleum.	5½c. per gal.
120	.100	.860	.540	3.240	9.890	1.900	. ...	22c.	Soft coal.	6.20 net ton.

TABLE NO. 2.

Operating Expenses, etc., of Seven Electric Roads.

No.	Average number of motor cars operated daily	Average number of trail cars operated daily.	Average daily mileage of motor cars.	Average daily mileage of trail cars.	Receipts per car mile, including mileage of trail cars.	Fixed charges per car mile.	Interest on funded debt.	Taxes, tolls—State, county and municipal, except water taxes.	Gross operating expenses per car mile, exclusive of fixed charges.	Maintenance of roadbed and track.	Maintenance of line work, including underground wiring.
					Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.
1...	39⅛	......	127	.....	19.860	......	......	.....	9.690	.....	. ...
2...	17	......	89½	......	25.263	7.222	6.861	.861	17.974	.773	.206
3...	280	5	70	56	40.280	3.860	1.000	2.360	25.440	2.520	.730
4...	10	4	120	120	13.500	9.000	......	......	9.000	......	... ..
5...	10	. ....	100	......	15.000	6.400	......	......	..... .	......	......
6...	5	......	96.6	.. ...	......	......	......	.....	16.000	.110	.070
7...	37	.... .	100	......	28.880	......	2.560	.....	18.580	2.500	.580

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[1] Abstract of a report submitted at the meeting of the American Street Railway Association, Cleveland, Ohio, Oct. 19-21. Wm. M. Ramsey, Frank R. Greene, John L. Heins, committee.

Table No. 2.—*Continued.*

Operating Expenses, etc., of Seven Electric Roads.

Maintenance of power plant, repairs on engines, boilers, etc.	Maintenance of plant in general, buildings, etc.	Maintenance of rolling stock; car bodies, trucks, etc.	Maintenance of motors, inspection and shopwork, electrical and mechanical.	Cost of power—fuel, oil, waste, etc., wages of employees.	Cost of transportation—wages of conductors, motormen, dispatchers, etc.	General expenses—salaries, legal, accidents, etc.	Net earnings per car mile.	Wages of conductors and motormen per hour.	Kind of fuel used	Cost per ton.
Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.		
....	....	....	..	....	....	....	.9 670	15½	Slack at 1.90;	Lump
.411	.040	3.450		3.301	8.750	1.091	.0067	24	Wood	3,000, by the year
.360	.330	1.590	2.720	3.560	11.420	2 220	14.3400	22½	Lump coal	3.92
....	....	....	....	....	1.500	....	4.0000	12½	Soft coal	1.25
.420	. .	1.230	2.360	3.200	....	....	3 4200	13	Soft coal	1.32
....	....	.740	...	3.840	8.740	.620	5 2300	14	R. O. M.	3 00
....	....	2.360	2.380	2.840	6.900	2.210	6.6100	20⅛	Slack	1.21

The first noticeable difference in the condition under which the two roads operate lies in the fact that road No. 1 operates daily an average of 298 trail or tow cars, while road No. 3 operates only grip cars. Road No. 1 operates 1.54 tow cars for every grip car operated, or a daily mileage of 203.2 for every train of one grip car and 1.54 tow cars to every 100 miles made by a train of one grip car only, which road No. 3 operates. Now if the expense of operating increased *directly* as the mileage, whether made by grip or by tow cars, a direct comparison of these two roads would be possible; but such is not the case. Road No. 3 is evidently at a disadvantage. The same difficulty occurs in the comparison of certain electric roads with one another.

A very excellent method of correcting this error has been formulated by Dr. Cary T. Hutchinson, and is here presented by his kind permission. It is evident that what is wanted is a formula which will represent the ratio of cost per car mile, as ordinarily counted, to cost per motor car mile, for any item of expense.

Dr. Hutchinson's method is as follows:

Let $t =$ No. of miles a train of two cars run per day.
" $m =$ " " motor car alone runs "
" $a =$ cost per train mile for any special item, *e. g.*, cost of fuel.
" $b =$ cost per motor car mile—the same item.
" $N = 2t + m$ equals "Car Miles" as ordinarily counted.
" $r = a/b$ equals ratio of cost per train mile to cost per motor car mile for any given item.
" $c =$ cost per car mile, counting trailers same as motor cars. This is the figure ordinarily given.
" $c\,N =$ total cost of operating line per day—for that item.

Then $a\,t + bm = c\,N$ for any item of expense.

but $a = br$

$$\therefore\ b\,(tr + m) = c\,N$$

$$b = \frac{c\,N}{t\,r + m}$$

$$b = \frac{c}{r\frac{t}{N} + \frac{m}{N}} \qquad (1)$$

$$a = b\,r \qquad (2)$$

Now $\frac{t}{n}$ and $\frac{m}{N}$, the ratios of train and motor to total mileage, are known.

Then r must be determined for each item of expense.

Table Showing Statistics of seven Electric and one Cable Road.

By permission of Dr. Cary T. Hutchinson.

Operating Expenses.	Mileage 4,750,000 No. 1.		Motor miles No. 2.		704,913 No. 3.		1,345,149 No. 4.		1,500,000 No. 5.		2,744,000 No. 6.		1,098,000 No. 7.		2,725,000 No. 8.	
	Cents	%	Cents	%	Cents	%	Cents	%	Cents	%	Cents	%	Cents	%	Cents	%
1. Maintenance of Roadbed and Track	.....	.....	.....	.....	1.040	8.45	2.51	12.66	.....	.....	.....	.....	1.516	10.80	.505	4.60
2. Maintenance of Line	.....	.....	.....	.....	.100	.81	.53	2.67	.145	.204	.....	.....	.516	3.82	.....	.....
Total	.159	.205	2.00	2.10	1.140	9.26	.....	15.33	.....	.....	.300	2.80	....	14.62	.....	.....
3. Meintenance of Power Plant:																
(*a*) Repairs of engines and boilers	.....	.....	.....	.....	.050	.40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
(*b*) Repairs of dynamos	.....	.....	.....	.....	.007	.01	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
(*c*) Miscellaneous repairs	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	.....	.....	.....	.....	.057	.41	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4. Cost of Power:																
(*a*) Fuel	.....	.....	.....	.....	.830	6.75	.....	.....	.675	9.40	1.280	11.90	.....	....	.....	.....
(*b*) Oils, waste, water and other supplies	.331	4.26	.391	4.12	.200	1.63	.....	.....	.412	5.64	.440	4.10	.....	.....	.....	.....
(*c*) Wages of engineers and firemen	.162	2.09	.223	2.35	.700	5.70	.....	.....	.168	2.35	.....	.....	.....	.....	.....	.....
(*d*) Wages of dynamo tenders, etc	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.500	4.65	.....	.....	.....	.....
Total	.493	6.35	.614	6.47	1.730	14.08	2.84	14.80	1.255	17.39	2.220	20.65	1.304	8.72	2.83	25.80
5. Maintenance of Rolling Stock:																
(*a*) Repairs on motors, except gearing	.....	.....	.....	.....	.905	7.35	.....	.....	.244	3.40	.....	.....	1.402	9.40	.....	.....
(*b*) Repairs on gearing and trolleys	1.040	13.40	1.430	15.10	.234	1 90	2.38	12.00	.....	.....	.....	.....	.....	.....	.....	.....
(*c*) Repairs on car bodies and trucks	.435	5 60	.542	5 70	.528	4.30	2 35	12.00	.315	4.40	.....	.....	.....	.....	.....	.....
Total	1.475	19.00	1.972	20.80	1.667	13.55	4.73	24.00	.559	7.80	1.800	16.80	.....	.....	.715	5.50
6. Transportation Expenses:																
(*a*) Wages of conductors and motormen	.....	.....	.....	.....	4 560	37.14	6.98	35.30	4.678	65.50	4.650	43.29	4.815	32.00	4.00	36.40
(*b*) Wages of starters, switchmen, track sweepers, etc	4.330	56.00	4 930	52.00	.485	3 95	.....	.....	.103	1.44	.515	4.80	.....	.....	.....	.....
(*c*) Cleaning and inspecting cars and motors	.....	.....	.....	.....	.290	2.35	.....	.....	.383	5.35	.....	.....	.....	.....	.....	.....
(*d*) Oil, waste and other supplies	.....	.....	.....	.....	.485	3.95	.....	.....	.036	.50	.....	.....	2.693	18.00	.....	.....
(*e*) Accidents to persons and property	.....	.....	.....	.....	.007	.01	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
(*f*) Miscellaneous	.172	2 05	.215	2.26	.477	3.90	.....	.....	.....	.....	.100	.93	.....	.....	.....	.....
Total	4.502	58.05	5.145	.....	6.304	51.30	.....	.....	5.200	7.29	5.265	.....	7.508	.....	5.62	51.30
7. General Expenses:																
(*a*) Salaries of officers and clerks	.437	5 65	.600	6.34	.....	.....	.....	.....	.....	.....	.132	1.23	1.051	7.00	.....	.....
(*b*) Office expenses	.132	1.70	.182	1.92	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
(*c*) Advertising and printing	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.250	2.32	.....	.....	.....	.....
(*d*) Legal expenses and damages	.174	2.25	.240	2 54	.....	.....	.....	.....	.....	.....	.102	.95	.291	1.95	.....	.....
(*e*) Insurance and taxes	.384	4.96	.530	5 60	.....	.....	.....	.....	.....	.....	.153	1.43	.184	1 23	.....	.....
(*f*) Miscellaneous	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.523	4.90	1.090	7.30	.....	.....
Total	1.127	14.55	1.552	16.40	1.402	11.40	2.21	11.2	.....	...	1.160	19.83	2.616	17.48	1 30	11 80
Grand total	7.756	100	9.483	100	12.30	100	19.80	100	7.159	100	10.75	100	14.915	100	11.00	100

Therefore, for

1. $b=1.14c$, $r=1.5$
2. $b=1\ 36c$, $r=1$
3. $b=1.18c$, $r=1.4$
4. (a) and (b), $b=1.18c$, $r=1.4$
(c) and (d), $b=1.38c$, $r=1.$
5. (a) and (b), $b=1.38c$, $r=1.$
(c) $b=1.25c$, $r=1\ 25$
6. (c) $b=1.14c$, $r=1.5$
(b) (c) (d) (f) and (e), $b=1.25\ c$, $r=1.25$
7. $b=1.38c$, $r=1.$

These are the figures used in computing cost per motor car mile in the case of the No. 2 railway. No other line used trailers.

"I take for r the following values:

"*First.*—Maintenance of roadbed and track, $r = 1.5$; although there are two cars instead of one, yet the trail car is by no means as hard on the rails as is the motor car.

"*Second.*—Maintenance of line, $r = 1$. It is the same whether there is or is not a trail car.

"*Third.*—Maintenance of power plant, $r = 1.4$ Because I have found by experience that under average conditions a train requires about 1.4 times the power of a motor car, and maintenance should be assumed proportional to power developed.

"*Fourth.*—Cost of power. (a) and (b) fuel and supplies, $r = 1.4$, as above. (c) and (d) attendants, $r = 1$. Because for a good size plant no more men would have to be employed in the power house if all the cars hauled trailers; the force required is not proportional to the output, but is constant within pretty wide limits.

"*Fifth*—Maintenance of rolling stock. (a) and (b) repairs to motors, $r = 1$. (c) repairs to cars and trucks, $r = 1.25$. Repairs to trail cars are very much less than to motor cars.

"*Sixth.*—Transportation expenses. (a) carmen, $r = 1.5$; three men on a train and two on a motor car. (b), (c), (d), (e) and (f) may all be bunched at $r = 1.25$.

"*Seventh.*—General expenses, $r = 1$."

Referring again to our table of statistics: No. 1 road expends .925c. per car mile for the item of cost of power, and No. 3 road expends for the same item, 1.07c., and this, notwithstanding the fact that road No. 3 only pays $1.21½ per ton for fuel, while road No. 1 pays $1.47 per ton.

Using for r the value assigned above for cost of power, 1.4, our equation reduces to $b = 1.07$c., or in other words .925c. should be multiplied by 1.07 to bring it on a basis of comparison with No. 3 road. This gives us .99 c. for No. 1 road as against 1.07c. for No. 3. The difference which still exists may be accounted for either by reason of a possible difference in the efficiencies of the two power plants, or by the possibility that one road may operate more cars to do the same amount of business than the other road.

This method of comparison can be used satisfactorily for any roads, cable or electric, providing the necessary data has been obtained as to motor car miles and train miles, and providing experience and careful observation have enabled the investigation to assign approximately correct values for r, which will differ in different cases. But there are yet many discrepancies to explain, for which we must seek other reasons. Why should the gross operating expenses of No. 3 electric road exceed the gross receipts per care mile of No. 4 electric road by nearly 100 per cent., and yet both roads still have a fair percentage of their receipts left for dividends? No. 4 road is a small road, and No. 3 is a large one, but we cannot argue that small electric roads have a better chance for profits than large ones. It is fair to assert that study of No. 3 report would lead to the conclusion that either there is more in the road than is brought out of it, or that the only thing that justifies the outlay of 25½c. per car mile (trail car mileage included), is the receipt of over 40c. per car mile, to do it with.

For a comparison of an average cable road with an average electric road, let us take No. 3 cable road, and compare it with No. 7 electric road. The cable road has been shown to be something better than the average, and the electric road is known to the writer to be at least up to the average. These two roads afford us a better opportunity than any other two which we might select, for the following reasons:

1st. Both are located in the same city, where climatic and other local conditions are the same.

2d. Both roads are of the same magnitude.

3d. Fuel and labor cost the same in each case.

4th. Neither road operates trail cars.

The cable road has the advantage in route as to grades and curves; otherwise, the roads offer excellent opportunities for comparison. It might be added that the investment in each case is up to the average, that is, is not extravagantly large, and yet is ample for the business transacted. Each road may be regarded as typical of its class. We see, upon examination, that the cable road has the greater fixed charges by 1.7c. There is a difference of 1c. in the gross receipts in favor of the cable road; one cent of which may be said to be due to the larger gross receipts; but resorting again to the comparison by "figure of merit," we find a ratio of .00015 to .00020, or nearly 3 to 4 in favor of the electric road. This simply means that each dollar invested in the cable road will earn .00015 in one day, whereas each dollar invested in the electric road will earn .00020 in one day. The total investment in the case of the cable road in this case is 2⅛ times the total investment in the case of the electric road. The capital stock alone, exclusive of bonds of the cable road, is 2.4 times the capital stock of the electric road. What is our conclusion from these facts, or can we draw a conclusion on which we can stand? We have not been conservative in our statements thus far, but are, of course, not infallible. "One swallow does not make a summer"—nor do the examples we cite determine the whole matter once for all. The cable road has its place firmly established in the transportation business of the Pacific Slope, and we, who are unacquainted with the conditions met with there, cannot presume to say that the electric railway would do the same work better and more efficiently. We are tempted to say so, but the interests concerned are too great to be trifled with in so dogmatic a manner. The cable roads have their methods pretty well digested, and their figures are, as a rule, reliable. The electric roads are as yet, with few exceptions published in this paper, in the dark as to what they are doing—except that they have enough left to satisfy stockholders—in fact 89 per cent. of the electric roads heard from report dividends from 5 to 12 per cent.

We believe that cable road practice has reached the stage where but little room is left for improvement. They have been developed, improved and operated by the best engineering skill which the country affords. Nearly all are on a good dividend paying basis; but whatever the past experience of the two systems has been, or whatever the present status of the two may be, we are only voicing the convictions of well-informed engineers, when we say that electric systems will continue to increase in efficiency (by which is meant earning capacity), until all rivals are distanced, and only one method of rapid transit is recognized —the electric car.

EXPERIMENTS ON THE EXPANSION OF CONTINUOUS RAILS[1]

BY A. J. MOXHAM.

THE author introduced his subject by a short history of the evolution of the street railway joint, the problem being finally attacked by supplying a device based on the theory of stopping all motion. In this, two points were essential:

First, to hold the rail against motion by means of the fastening bars; to which end it was necessary to,

Second, hold the fastening bars against motion by means of the bolts.

The joint of to-day is structurally stiff, heavy enough to take up the jar of the blow without transmitting it all to the nuts, a yielding fit that tends to counteract all motion, and large bolts, carefully located with a view to vibration. In itself good, and as it now stands, to a certain extent, capable of economical use, and far ahead of its brother on the steam road, even of the heaviest construction. But even so *it will not do.* If not, "What then?" There is but one answer; *no joint at all.* While apparently a bold suggestion, it is at least worthy of thought and discussion. That the rail can be made continuous by mechanical means we know, but what of expansion and contraction? *We will do without it;* and that we can do so, the sequel, the author thought, would show.

To the credit of Mr. Philip Noonan belongs the first practical idea of a continuous rail. His theory, in a nutshell, may be described as gripping the rail at one end and permitting the wave motion or flow induced by passing trains to be, so to speak, rolled out before the train wheels, into a tension device that within certain limits holds what it gets. He provides against danger of rupture by a spring device which limits the strain. He put his ideas to a test, built a considerable stretch of track (some three miles) on the Lynchburg and Durham Railroad, at or near Gladys Station, Va., and it to-day is in successful use. Expert investigation and report indorses it in all essential particulars, though it is perhaps questionable whether the fastenings he used to make his rail continuous are strong and rigid enough to prohibit all yield. For details, those who care to investigate may be referred to a pamphlet on the subject, that can be obtained by addressing the inventor at the above named place.

At a glance, the problem of a street railway differs from the steam road in that the former is surrounded by the roadbed, while the latter is, at least, to a great extent, exposed. The effect of the surrounding roadbed is twofold. First, by its great surface friction, it tends to hold the rail against change, stops all wave motion, and second, it to some extent modifies the temperature. The problem was to find a measure of value for both. To this end the following experiment was made:

One rail in a section of track was so connected that it was in reality a continuous rail. One side of the track was taken instead of both, because it was thought the parellelism of the adjacent rail would at once indicate changes that were expected to occur, which perhaps other measurements might fail to disclose. The length was 1,160 feet, and the profile one that embodied level track, up grade and down grade. As the track was laid and in use, it was determined that it was best to make the rail continuous by a joint rigid and stronger than the rail, so as not to have to remove the whole roadbed. This because the roadbed, which was macadam, had become solidly packed and represented normal conditions hard to obtain if once disturbed. When the experiment was made it was thought questionable whether the rail, when prevented from expansion and contraction, could be at all restrained by the roadbed; hence all the restraining power offered was to be retained. At the end of each separate rail the usual one-fourth of an inch had been left for expansion. This was filled by a carefully measured dog, made of the same section as the rail, cut to fill the space tightly and then driven into place.

As the joints were to be stronger than the rail itself, and for connection body-bound, machine turned bolts were decided upon. The two side bars were of steel, 4 x 1¾ inches thick, and 5 feet 4¼ inches long. The body-bound bolts were 18 in number, and 1¼ inches in diameter.

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[1] Abstract of a paper read before the American Street Railway Association, at Cleveland, Ohio, Oct. 19–21.

To insure an absolute fit was deemed a necessity. It was done as follows: A number of jigs were made having a hardened steel guide for the drill. With this the bars were drilled in pairs, and as drilled each bar carefully tested by the standard. The holes were drilled $\frac{1}{32}$ of an inch smaller in diameter than ultimately needed. The roadbed surrounding a joint being removed, one bar was clamped to the rail, and the holes (also $\frac{1}{32}$ of an inch small) were drilled through the web, using the bar as a guide. After the temperature of the parts was equalized, the adjoining bar was then adjusted and a rose-bit reamer carefully worked through the three holes. As quickly as one hole was completed the gauge was taken, and one of a series of machine bolts (previously turned to a standard slightly large) was accurately turned for this special hole; and so to completion. Each bolt was a driving fit. It took 24 hours to properly adjust each joint. The track was thus made continuous.

At five points along the line heavy stakes were firmly fixed in the ground, one on each side of the road, in the top of which were set small wire nails. A thin but strong cord was tightly stretched from stake to stake, the tops of which were several inches above the top of the rail. Directly underneath this line a mark was made on the head of the rail with a cold chisel. Measurements were taken from the stake to the chisel mark, and from the top of the rail to the tightly stretched cord. Observations were taken at these five points, in the manner indicated, throughout the whole summer.

The work was started on the 19th of March, and finished on the 25th of April, 1892. The average temperature during the work was 43.04°, the maximum 81° and the minimum 10°. The section of rail used in the track is of the girder type, 6 inches deep, weighing 78 lbs. to the yard. The rail is fastened to the ties by means of tie-plates, and the gauge is preserved by tie-rods spaced 10 feet apart. The ties are spaced 11 to 30 feet apart, and the roadway is excellent macadam.

Anticipating the unknown, provision was made for a possible sudden stoppage of the line, by means of portable connecting tracks kept in readiness. In order to further explain whatever might occur, careful preparations were made to read the temperature of the rail at different parts above and below ground during the experiment. As the rail was in use, this was done by a special rail in the adjoining roadbed, and in order that the scope of investigation should be fully complete, the temperature was continuously taken at the head of the rail, at the lower flange of a 6-inch rail, or a 7-inch rail and of a 10-inch rail, or its practical equivalent, a 10-inch I beam. Simultaneously readings of temperature were taken as follows: Air in the shade; air in the sun; roadbed at a depth of 7 inches; roadbed at a depth of 10 inches.

A slight analysis of the tables compiled will suffice to prove to the practical railroad man that for all ordinary purposes, the rail may be assumed to be subject to nearly full air temperature, and that the roadbed will not suffice, as has been believed, to keep the rail temperature virtually regular. Steel is a far better heat conductor than earth, and the tables show that the whole rail (flange as well as head) closely follows the air temperatures. Readings taken over a long period, night as well as day, every 15 minutes (in Table No. 6) give the whole kaleidoscope of changing temperature. With this fact before us one element of doubt has been removed; but it also proves that the heating of the sun in the day, and the cooling of its absence at night, leaves the expansion and contraction most certainly there.

Now for its effects. The experiment has proved absolutely and beyond cavil, that it is restrained and held by the surface friction of the surrounding roadbed. From first to last, from a temperature of 22° below freezing point (or 10°), to a temperature of 89° above freezing point (or 121°), extending from March to August, there was *absolutely no movement of the track out of place.* Even at the ends was this true; proving that not only will the roadbed hold the track as a complete structure, but that it will do it consecutively. Once bedded, it will hold a rail 10 feet or 30 feet, as well as one 1,100 feet. On this point there is no room for error. The expansion in 1,100 feet, if not neutralized, would equal 5¼ inches, under the conditions here stated, and 5¼ inches would throw the rail out of line 14 feet, if it were held at the ends and permitted to bow in the centre. An expansion of one rail would mean about 6 inches in 30 feet out of line. The query arises, "What has become of it?" It is existent, and, like all force, it would flow to the point of least resistance. In the case of a street rail, buried in the roadbed, it is reasonable to believe this point is in a minute enlargement and reduction of the sectional area of the rail.

As to its effect upon the steel: Experts teach us that a variation of 7° in temperature, if held, would subject the rail to a stress of 1,000 pounds per sq. inch Taking a track laid at the low temperature of 40° and subject to a maximum of 120°, or a variation of 80°, the stress is equal to less than 12,000 pounds per square inch, much less than the elastic limit, and less than the strain put upon an ordinary bridge, or similar structure. It would therefore appear that the effect on the steel would be harmless.

On the face of it, therefore, there is nothing to prevent us abutting our rails, and this is but the prelude to an absolutely continuous track—*one without joints*—the rails welded by electricity, or otherwise connected one to the other, up to such lengths as may be deemed best.

As to its practical application, many precautions suggest themselves. It must be remembered that a track so laid will be like a huge spring under tension, absolutely safe and harmless when restrained by the roadbed, but ready to spring like a shot from a cannon if, while in this condition, the roadbed be removed. The part of common sense would appear to be to limit the length of a continuous rail to, say, five hundred or a thousand feet, with specially devised expansion joints at these intervals, or if desirable to take up the paving for repairs on a very short piece, the following would be effective: First remove only a foot of paving, then with a hack saw cut out, say, six inches of rail, thus removing the tension or compression, as may be. This done, the rest of the roadbed could be removed, starting from the cut part of the track, without danger. Be this as it may, it should be borne in mind that chained lightning is not a nice plaything, and therefore a lightning conductor is sometimes handy.

One important saving that would be effected by a "track without joints" would be in the weight of the rail. A rail of 100 pounds per yard is to-day in use, and next year will be extensively used. Perhaps without their knowledge, the cause of this has been the street railroad men's dearly bought and sad experience with joints. The joint being defective, the effort has been made to secure such stability of track as to relieve the joints by means of a heavy rail. In a 100-pound rail there are but 30 pounds of wearing surface, of which not more than 18 pounds can be used before the rail will have to be thrown out; therefore, there will be 82 pounds unused. For mere stiffness and rigidity, a 66-pound rail, if supported by the proper number of cross-ties, will answer every engineering demand, even of electric cars at high speed. Anything over this goes to the debit of "bad joints."

ECONOMY OF MACHINE SHOPS FOR ELECTRIC STREET RAILWAYS.[1]

BY JOHN H. BICKFORD.

THERE is great lack of uniformity in the operation of roads, and one can find hardly two which are following the same course, as regards repairs and renewals to motor equipment. The one thing to prove is, whether there is economy in maintaining a machine shop when there are so many manufacturing and supply companies which can furnish us with every conceivable thing we want (and many more we don't want) at short notice; and the local machinist stands ready to do our work at a price varying from fifty to seventy-five cents per hour for first-class workmen (and double price for apprentices).

After having bought the best apparatus, we must provide means to take care of and repair it, and the first thing to do is to provide competent help. On this last point hung the key to success. The author strongly advocated the employment of skilled mechanics, that is to say, men who are skilled in their particular branches, such as skilled armature winders, linemen, etc., in contradistinction to the machinist, who is usually so termed.

Skilled help being thus found to be necessary, the next thing was to provide a suitable equipment for maintaining the road and all apparatus in good condition, and for this purpose a repair shop was, in his opinion, indispensable. How far should the equipment of such a machine shop be carried? Should it be made a manufacturing establishment? There was surely a point where the line must be drawn. Would it be well to go no further than the mere making of repairs, or would it be better to go a little further and manufacture supply parts? The author here referred to the long experience of steam roads who had found it economical to maintain complete repair shops with competent master mechanics at the head.

In order to arrive at the results obtained in actual practice, the author sent out circulars requesting information on the points referred to and received replies from 66 companies operating electric roads.

Among the answers received he found many things to strengthen his belief that it is economical to maintain a machine shop, not only for repairs but for the manufacture of supply parts. It turns out to be a fact that no less than twenty-four roads are maintaining machine shops, doing all their own repairs and manufacturing many supply parts. They say unhesitatingly that there is economy in so doing. They give as their reasons: First, that they can *make* better material than they can *buy*; that they are perfectly familiar with the requirements and conditions of the business; they are operating the roads and are in a position to know just what is needed, and are better able to judge of the strength and durability of the apparatus than those who have never been in a similiar position. Was not this a natural consequence?

In presenting this he did not mean to cast reflection on the earnest efforts of his good friends in the manufacturing business, but he must say from personal experience that there was much material on the market to-day that was not up to the standard. Why? Simply because the makers of it do not understand thoroughly the requirements of the business. Some may be unscrupulous enough to put goods upon the market just for what is in them for a while, regardless of their stability; but he hoped this was not the case, for surely we had much rather believe to the contrary.

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[1] Abstract of report submitted to the American Street Railway Association at Cleveland, Ohio, Oct. 19-21.

A second reason given is, that there is a saving of from 25 to 50 per cent. by manufacturing the majority of parts.

From this and the experience of steam roads, the author concluded that there must be economy in machine shops for electric railroads.

The author then gave a classification of the answers received as follows:

10 *Cars or Less*.—Received answers from 16 roads; 14 of these buy all supplies and repair parts, and have not a machine of any kind; the other two have a drill press, small lathe and blacksmithing outfit.

10 *to* 20 *Cars*.—Received answers from 13 roads; seven of these have partially equipped machine shops, do all ordinary repairs, and manufacture many parts for renewals; the other six have not a machine of any kind.

20 *to* 30 *Cars*.—Received answers from 10 roads; six of these have well-equipped machine shops, do all repairs, and manufacture most parts for renewals; the other four have not a machine of any kind.

30 *to* 50 *Cars*.—Received answers from six roads; of these one has not a machine of any kind; one has only a wheel press; two have a drill press, lathe and blacksmithing outfit; the other two have fully equipped shops and do all repairs and make nearly all supply parts.

50 *or More Cars*.—Received answers from 12; two of these have only a drill press, lathe and blacksmithing outfit; nine have complete shops equipped with machines of all kinds and manufacture about everything necessary to maintain the equipment; one has a very extensive manufacturing establishment, outside of a complete repair shop, and also maintains a brass foundry. The remaining roads from which answers were received had no definite information to give. One or two said that they were getting ready to establish shops, and others were undecided what they would do.

Out of the 66 roads heard from, 36 were winding their own motor armatures and field coils, and the cost of armatures varied from $17 the lowest, to $75 the highest; the average was about $35, including all labor and material.

Fifteen roads had wood-working machinery, consisting principally of saw-table, band-shaw, surface-planer, and mortising machine. Seven roads are cutting their gears, but some of them find it no cheaper than to buy. They think, however, that the work and material are better, and for that reason it pays them. Others make all gears and think there is a saving in cost. Eight roads are building their cars, while several are rebuilding old cars, but make no new ones.

The author then gives a few of the prices for which supply parts are being made in the shops of the different roads. These figures are an average taken from 11 roads which are using Sprague, Thomson-Houston and Westinghouse double-reduction motors.

Refilling commutator (copper bars) $18.50; two halves armature bearing, Thomson-Houston, $3.96; single Sprague, $1.85; two halves axle bearing, $3.50; brush holder, $1.35; rocker arm, Thomson-Houston, $1.00; Sprague, $3.00; internal shaft (steel), Thomson-Houston, $10; Sprague, $3 00; internal pinion (steel), $4.20; internal gear, $3.88; axle gear, $5.66; armature pinion (steel), $3.58; trolley wheel (brass), $1.00; line frog, $1.90; clips for line hangers (brass), 15 cents; to bore and press on 30-inch wheel, 95 cents.

The average price for which roads sell scrap car wheels is $13.65 per gross ton; the lowest being $8, and the highest $20. Some roads have kept no account of cost of making repair parts, and therefore could give no prices. It is unnecessary to say that it would be wise to do so. With but two exceptions, the single-reduction costs less to maintain.

Nineteen roads are employing an electric engineer, and four have a superintendent and electrical engineer combined.

The results of these inquiries fully coincided with the author's opinion previously expressed, that there is economy in maintaining repair shops, and even manufacturing supply parts. Small roads, of course, might not find it profitable to go to this length, but many would find it to their advantage.

The report then gives the following list of machines which the majority of roads having machine shops are using:

One 20-inch swing, 10 foot bed, engine lathe; one 16-inch swing, 6-foot bed, engine lathe; one 16-inch swing, 6-foot bed, speed lathe; one 24-inch x 24-inch iron planer; one No. 3 or No. 4 Universal milling machine; one 45-inch upright boring mill; one 24-inch upright drill press; one 12-inch upright drill press; one 100-ton hydraulic wheel press; one open die bolt cutter and nut tapper; one medium size shaper; one tool grinder; two forges with power blower; one set of emery grinders; one grindstone; necessary bench tools and fittings for machines; one 10 h. p. motor to run machinery. Of course roads with a great number of cars would need to duplicate some of these machines, and add some others not mentioned.

Finally the author advocated the employment of a thoroughly competent electrical engineer, not one of the self-styled "electricians," but one who has a theoretical as well as practical knowledge of mechanical and electrical engineering.

IS A STANDARD RAIL HEAD POSSIBLE?[1]

BY JOHN T. OSTROM.

IN order to ascertain the prevailing practice, the author addressed inquiries to manufacturers from which the fact was developed that wheel treads vary from 1⅛ inches to 5 inches. Flanges from $\frac{7}{16}$ to 1½ inches. Rail from 16 pound T to 98 pound girder. One council unanimously requested the road to take up all girder rail and lay T rail instead Another specified both form of rail and weight (groove girder, 77 pounds), while others specify a rail of a particular manufacture, a rail with a stated width of wagon tram, etc.

Suggestions as to standard vary as much as conditions. On one point only all seem to agree, and Ohio voices the general sentiment, "Tram rails no account for anything or anywhere." One road writes: "There should no rail but a T rail be used where the city authorities will allow it." Another, "Plain T every time, under all circumstances of paving or traffic." Another, "There seems to be a popular prejudice against T rails for street work which is exercised wholly without reason; and, so far as the T rail for the very best service goes, there is no chance for argument."

Against these are suggestion for side bearing rail, with various widths of wagon flange and for centre bearing and groove girder rails; 88 companies operating 1,083 miles of track, suggest T rail; 60 companies operating 1,101 miles of track, suggest girder rail; 45 companies operating 1,243 miles of track, suggest a section of girder rail deep enough to be spiked direct to tie in paved streets.

There are at present, besides the various sections of the rail, over 90 sections of girder rail now on the market, with 15 different widths of head between 1½ inches and 2¼ inches. These rails have 10 variations in flange room or dip, from ⅞ inch to $1\frac{3}{16}$ inch.

The necessity for a standard recognized, is it possible to devise one that can be accepted as such? In response to inquiries already referred to, the author received replies from 306 roads, operating cars on 4,347.8 miles of track. Twenty of these roads operate with steam motors over 155 miles of track; 29 with cable motors, over 328 miles; 99 with horses, over 1,117 miles; 198 with electricity, over 2,748 miles; 59 have 625 miles of stringer rail track; 197 have 1,532 miles of T rail track; 146 have 2,190 miles of girder track.

This mileage he thought would justify him in assuming that the above reports may be reasonably taken to represent the condition of the street railway situation of the country to-day. Two hundred and sixty-four roads reported width of wheel tread on 3,937 miles of track. These varied from 1½ inch to 5 inches, in 14 different widths, 2 inches, 2¼ inches and 2½ inches being used in the majority of cases; 170 roads, operating 2,942 miles, use 2¼ inch wheel tread or less; 56 roads operating 568 miles use 2½ inch tread.

One hundred and forty-six of the electric roads use three-quarter inch wheel flange and under on 2,244 miles of road, and 24 roads use seven-eighths inch flange on 256 miles of track. By combining these roads, increasing the depth of wheel flanges below three-quarter inch to that point, and cutting down the seven-eighths inch flange to three-quarter inch, we would have 2,500 miles of track using our standard, or 95 per cent. of reported electric track.

The author finds that the wheel tread that most nearly approaches the necessities of the street railway world of to-day is a 2¼ inch tread, and the wheel flange one three-quarter inch deep. The apparent need is for a rail designed to carry such a wheel. Such a rail should have, in his opinion, a head flat, or nearly so, $2\frac{5}{16}$ inches wide, with a curve not over one-quarter inch on the gauge line corner, with a dip of one inch to the wagon flange in side bearing rails, and 1⅛ inch to bottom of groove in groove rails. The width of head and the gauge line curve can be made alike in both T and girder rails. Distance from centre line of web to gauge line in girder rail five-sixteenths inch. The author's reason for making the groove deeper than dip in side bearing rail, is that in the latter both head and flange are subject to wear, while in the groove rail the wear is confined to the head of the rail until the wheel flange strikes the bottom of the groove. Such a standard rail head he believed to be perfectly feasible. Its adoption by the Association would materially simplify both the track and wheel questions. It would give to manufacturers a clear idea of what street railway requirements are likely to be, and enable them to have such rails as may be desired ready for next spring's business.

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[1] Abstract of a paper read before the American Street Railway Association at Cleveland, Oct. 19–21.

The author also referred to a paper by Mr. Geo. W. Mansfield on "Rail Sections and Special Construction," read before the Massachusetts Street Railway Association, as containing valuable information.

A PERFECT OVERHEAD ELECTRIC CONSTRUCTION.[1]

BY CH. K. SMITH.

I GIVE only my ideas of how an electric overhead line should be constructed, based upon facts and information derived from personal experience and observation.

Iron or steel poles have proved to be the most desirable. I would therefore recommend the following: The poles to be of tubular iron, thirty-two feet in length, and made in three sections, in the usual way. The lower section should be at least seven inches in diameter, and the other two sections six inches, and five inches, respectively. The poles should be set in concrete, and at least six feet in the ground, and should not be more than 125 feet apart. The top of the pole should have about two per cent. of rake away from the curb, and should be fitted with a suitable pole clamp, so that the span wire can be easily adjusted to the required height, which should be twenty-two feet above the track. On top of the pole should be a malleable iron cross-arm to carry the feeder wires, and guard wire spans. This cross-arm should be insulated from the pole by means of a wooden plug inserted in the top of the pole. The insertion of the joints of the pole should be at least eighteen inches, and the joints should be made solid throughout their entire length by means of sleeves, or other contrivances. If these joints are not properly made, the poles will not stand the strain. For curves, or extra strain, there should be larger poles of the same make.

Span wires should be of No. 4 "B. W. G." silicon bronze wire, and should be fastened to pole clamps by means of insulated turnbuckles. Great care should be taken in insulating these turnbuckles from the poles.

All well-built lines should be sectional, and the trolley-wire should not be of too great a size, as it would then call for clumsy supports. As it is not the main current wire, it can be of a smaller size. I would therefore recommend No. 4 "B. W. G." silicon bronze wire, which affords sufficient carrying capacity, and has great strength and durability. Sections should not be of a greater length than two miles, and should be separated by trolley-breakers, of which there are now a number of good ones in the market. In cities and villages, where there is great liability of fires, it would be advisable to put trolley-breakers at shorter intervals. Trolley wire hangers and pull-off brackets should be of the lightest make possible, and still have the required strength and the very best insulation. There is a variety of such hangers and brackets now in the market.

As it is important to have as small a number of joints as possible in the trolley wire, it should be put up in mile lengths, and twisted splice joints should be made, and brass cone-shaped tubes slipped over the wire before the splice is made. After completing the splice, the larger ends of the tubes should be brought together over the splice and a little solder dropped through a small hole made in the tubes for that purpose, in order to keep the joint in place. Overhead switches, or switch-pans should be avoided, if possible, as they become a source of great annoyance. I would strongly recommend a double trolley wire for a single track road.

Great care should be taken in erecting the guard wire spans. They should be properly insulated from the cross-arm by means of a strain insulator, or something equally as good, and should be of at least No. 6 best galvanized iron wire. There should be two guard wires over each trolley wire at least three feet apart and four feet above the trolley wire. The guard wire must be well insulated from the guard spans; in case of other wires falling, this would be a great importance. Pull-off and anchor guy-wires or other wires for the same purpose, must be of the very best material, and of at least No. 8 galvanized iron wire.

Feed-in taps must not be more than five poles apart and should take the place of the trolley span wire at that point. They should be of at least No. 0 insulated wire. The trolley wire being sectional, it is necessary to run a feeder wire to each section. I would therefore recommend that the feeder wire be at least thirty per cent. larger than the occasion demands. It will be found that this is money well invested. The insulation on the feeder wire should be the best that can be procured, and I would advise using locust or iron pins with mica insulators or something equally as good, for the purpose of fastening the feeder wire to each pole, and great care must be taken to protect it from trees and other obstructions.

A cut-out box should be located on the pole at each trolley breaker, and should not carry a fuse. It should have the same wire running through it as there is on the outside. The fuses should be at the station, with amperemeter and cut-out switch for each section; then, in case of trouble on any section, the location can be easily seen, and that section cut out, if necessary, until repaired. Lightning arresters are of great importance on the line, and I would strongly recommend using them at least every thousand feet. They can easily be attached to the poles, and can be protected by means of a box.

In conclusion, I would say that no matter what expense is incurred for material, or care used in constructing, a good line cannot be ensured without a thorough daily inspection.

ANNUAL MEETING OF THE AMERICAN STREET RAILWAY ASSOCIATION, CLEVELAND, OCT. 19, 20 AND 21.

THE annual meeting of the American Street Railway Association was held at Cleveland, O., on Oct. 19, 20 and 21, with headquarters at the Hollenden Hotel, and exhibits at Army and Navy Hall, and meetings at the Y. M. C. A. The membership now includes over 200 roads, the attendance from which was very large. As for supply men, they were simply innumerable.

The convention was called to order on Wednesday morning at the Y. M. C. A. by Mr. John G. Holmes, president, and Mr. W. J. Richardson, the secretary.

An excellent address of welcome was made by Mayor Rose, who while praising street railroads, especially cable and electric, advised his hearers to deal fairly with the community in which each worked, and not to be too grasping as to franchises.

To this Mr. Holmes responded admirably, saying the course of his address :—

This city offers a fine opportunity to study practical street railroading. Here we see the most advanced ideas of construction, the highest development of the electric system, and a splendid new cable plant, as near perfect as capital, invention and engineering skill have been able to make it. And by the way of contrast and historical interest, we find a few horse car lines to remind us of the meetings a decade ago, when we used to grow excited over discussions of the relative merits of the horse and the mule as a street railway motor.

This is pre-eminently an electric age, and most of us believe that as yet we are only standing on the threshold. The horse and his half brother, the mule, are destined to disappear. The cable system, from its very nature and cost, must be confined to the thickly populated districts of large cities, but there seem to be no limitations to the electric railway. It leaps over the city lines wherever there is a large suburban town calling for rapid transit, it girds the summer lakes, it is forcing its way through the scenic splendors of the Niagara gorge, close beside the water's edge, and when the convention goes to California, as no doubt it will some day, we may expect to ride around the Yosemite on a train of trolley cars. And how rapidly it has all come about. It was just ten years ago that the president of this Association, at the Chicago meeting, with a foresight, which must have been born of intuition, ventured to predict that the lightning would some day be harnessed to the horse car. We laughed at his visionary prophecy, and dismissed it from our minds as a piece of optimistic nonsense. But the prophet of a decade ago is with us to-day, and can take revenge by saying "I told you so."

This is an assembly of practical men who have come together not to vie each with the other in making extravagant predictions, but rather to contribute each to a common fund the results of his observation and experience. The congestion of traffic in our business centres, the increasing throngs of passengers of the working class nights and mornings as the day of tenement houses gives way to the age of suburban cottages, the safeguards against accidents required by the exigencies of rapid transit, the labor question, the unjust and burdensome taxation of corporations, the ways and means of increasing traffic and reducing the cost of maintenance and operating expenses, give us plenty of things to talk about. The principal subjects for discussion cover a wide range of practical matter having an important bearing upon street railroading as a business conducted for profit rather than for philanthropy, and the reports of the special committees will be worthy of your closest attention and most careful consideration.

SECRETARY RICHARDSON then read his report showing 206 companies in full standing of membership, a gain of 22 over last year. The outlook was excellent. Milwaukee had been selected as the place for the next, twelfth, annual meeting.

The treasurer's report showed a balance of $1,524 on receipts of $7,574.

MR. D. S. LONGSTREET read a historical sketch, giving an account of the formation of the Association. He was thanked for it.

MR. G. W. BAUMHOFF then read a valuable report on A Model Electric Railway Roadbed and Underground Wiring.[1]

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[1] Abstract of a report submitted to the American Street Railway Association, Cleveland, Ohio, Oct. 19-21.

[1] See page 396.

Convention then adjoined until evening, when a long discussion was had on the details of Mr. Baumhoff's paper, in which a number of members joined.

A resolution was adopted requesting the chair to appoint a committee of five to act in conjunction with the executive committee in deciding the feasibility of forming an industrial association. The object of the proposed Association is to pave the way to advanced ideas by having a stated place for exhibits of appliances and authorized agents to make experiments for the good of all. The gentlemen appointed on the committee were Messrs. H. C. Paine, Milwaukee; D. F. Longstreet, Denver; O. T. Crosby, Boston; W. M. Wharton, Jr., Philadelphia; H. A. Everett, Cleveland. The convention then adjoined until 10 o'clock Thursday.

The supply men also took up at a special meeting in the evening the question of a supply organization, Mr. J. E. Lockwood presiding. There was a powerful discussion, and a committee was appointed to report next evening. The project was abandoned, however, before the close of the convention.

THURSDAY MORNING SESSION.

The delegates reassembled at 11 o'clock for the morning session. In the absence of the president, Mr. Thomas H. McLean, general manager of one of the large New York companies, occupied the chair. A communication was read from President Holmes, stating that he had suddenly been called away from the city by a telegram announcing the illness of a member of his family. The committee on nominations was announced as follows: Messrs. Charles Cleminshaw, Troy, N. Y.; W. A. House, Baltimore, Md.; Albert Johnson, Cleveland; J. E. Rugg, Pittsburgh; G. W. Baumhoff, St. Louis, and V. Cronyn, London, Canada.

It was moved that the time for discussion of papers be limited to a half hour and that no member be allowed to hold the floor more than five minutes. The report of the committee on "A Perfect Overhead Construction," concerning which a paper had been prepared by Mr. George W. Baumhoff, of St. Louis, was ordered printed in the minutes without discussion. A paper on "Economy of Machine Shops for Electric Street Railways," [1] which was prepared by Mr. J. H. Bickford, of Salem, Mass., was presented to the convention. A discussion, in which many practical points were brought out, followed the reading of the paper.

Mr. **Wm. Richardson**, of Brooklyn, N. Y., introduced a resolution expressing the sympathy of the convention with President Holmes and the regret experienced on account of his departure.

A paper on "The Relative Cost of Operating Horse, Cable, and Electric Roads" [2] was read by Secretary Richardson. The report was prepared conjointly by Mr. W. M. Ramsey, superintendent of the Federal Street and Pleasant Valley Railway Company, of Pittsburgh, Mr. F. R. Greene, secretary of the Chicago Railway Company, and Mr. John Heins, superintendent of the Brooklyn City and Newtown Railroad Company. The ensuing discussion showed a great preponderance of feeling and experience in favor of electricity.

A report was presented showing that the exhibit at the World's Fair next year will be very fine.

A report from a special committee of the Massachusetts Street Railway Association, asking the convention to take action touching the question of grade crossings and legislation concerning them was presented by Mr. G. W. Mansfield, chairman of the committee. One of the recommendations was that an automatic signal system be put in operation, which system would indicate at one thousand feet distance the approach of trains on either the street or steam railway. The executive committee was allotted the duty of preparing a suitable report concerning the matter in question. After the noon adjournment the members of the convention were photographed on the steps of the Young Men's Christian Association Building.

AFTERNOON SESSION.

The afternoon session was opened at 4 o'clock by a paper embodying the report of the committee on Standards for Electric Street Railways, read by Mr. O. T. Crosby.[3] Associated with Mr. Crosby in the preparation of the report were Messrs. H. J. Bettis, of Atlanta, Ga.; Edward E. Higgins, of Cleveland; Charles W. Wason, of Cleveland, and Julius E. Rugg, of Pittsburgh, Pa.

Mr. **A. L. Johnson**, of Cleveland, reported for the nominating committee, the following selection of officers to serve during the coming year: President, Mr. D. F. Longstreet, of Denver, Col.; first vice-president, Dr. A. Everett, of Cleveland; second vice-president, Mr. Joel Hurt, of Atlanta, Ga.; third vice-president, secretary and treasurer, Mr. W. J. Richardson, of Brooklyn, N. Y.; executive committee, Messrs. J. G. Holmes, of Pittsburgh; J. D. Crimmins, of New York; T. J. Minary, of Louisville; J. R. Chapman, of Grand Rapids, and B. E. Charlton, of Hamilton, Ont. They were all elected.

Owing to the exhorbitant charges which the hotels of some of the former convention cities have inflicted upon the members of the Association, a resolution was introduced recommending that the by-laws be so amended as to give the executive committee the power of changing the place of any meeting 60 days previous to the meeting by notifying every member of the Association to that effect. The question was discussed at length, and the final result was the tabling of the resolution.

Messrs. Wharton and Eppley were appointed a committee to escort the newly elected president to the chair. Before taking his seat Mr. Longstreet made a short address thanking the association for the honor, and expressing his interest in the organization.

The secretary presented a report of the committee meeting with the special committee from the supply men concerning the formation of a supply men's union. It was voiced as the sentiment of the Street Railway Association that there was no need to either party that a separate organization should be formed by the supply men.

On motion it was ordered that the nomenclature recommended in the report of the committee be adopted as the standard to be used by the Association.

The business of the convention not having been completed at the afternoon session, adjournment was taken until 10 o'clock Friday.

FRIDAY MORNING.

On the opening of the morning session, the paper by Mr. A. J. Moxham on "Experiments on the Expansion of Continuous Rails" [1] was read by title. The same thing was done with the paper by Mr. J. T. Ostrom, entitled, "Is a Standard Rail Possible." [2]

A resolution was passed inviting foreign street railway men to the World's Fair.

Thanks were voted to the Short Company for its many courtesies.

The Convention adjourned to meet at Milwaukee, third Wednesday in October, 1892.

EXHIBITS.

In their exhibition this year, the General Electric Company have surpassed all the previous exhibitions made in the old days of the Edison and Thomson-Houston companies. They are now able to show what was best by the combined talent of the two former rivalries. The exhibition was in every way worthy of so large, energetic and prosperous a corporation, and has gone far to convince any still skeptical of the merits of their street railway system. The arrangement of their exhibition permitted an examination of their entire railway system without any exertion to locate the different devices. We were especially taken with their motor exhibit. It seems a late day to say anything further about the motors of the General Electric Company, but we were enabled to see them thoroughly this time and gain a knowledge of certain advantages which they possessed which we had not had an opportunity of previously examining. On a "Brill" truck, 2 W. P. 30 single reduction railway motors were mounted, showing their lightness, general compactness and ease of adaptation. The W. P. 50 motor, with the hollow field and field coil thrown back, allowed one to examine the interior parts and analyze the claim of the motor to the possession of fewer parts than any other railway motors. The S. R. F. 30 motor—a modification of the old F. 30—was arranged next to this, and is described in detail elsewhere in our pages. Next to this, we found the Standard S. R. G. railway motor, which is already too old a friend of the street railway men to need further description. An Edison No. 14 motor was mounted in the centre of the exhibition. This also we have previously described at length. We saw here an entirely new device—a gear press for applying and removing gear wheel from motors. We were struck by the simplicity of this device, and predict its wide adoption by the users of motors of what description soever. The series parallel controller next claimed attention. From this, any objectionable features which were found in those first made had been eliminated, and the series parallel controller as it now stands will prove a great economic element in calculations of street railway managers. One of the particular features of the exhibition were the overhead parts described before. They were arranged on a long, sloping board which showed them off to considerable advantage. In order to render them still more conspicuous, they had been carefully plated and polished so that this board shone like a jeweler's show case and quite as attractively. By the side of all this glory was shown "ye ancient appliances" of only six years ago. Surely, no greater proof of the rapid development of the electric street railway could be given than this—the contrast between these old and obsolete appliances and the practical devices of the present day.

Another striking exhibition which they had was their station switchboard equipped with automatic circuit breaker and current indicator of the latest and most improved type. This stood by the side of a board on which were mounted several of the Thomson wattmeters working, in order to show their method of operation and record. Two special car fixtures completed the exhibit.

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1. See page 403. 2. See page 400. 3. See page 398.

1. See page 402. 2. See page 404.

Small electric lamps outlined the name of the company in different positions around the exhibit; and, in the centre was an American eagle perched on the top of a shield formed of small incandescent lamps of the patriotic colors.

The General Electric Company ran two magnificent cars over the East Cleveland Company's lines—one, a special vestibule car upholstered in deep brown plush, and furnished with easy chairs. This was mounted upon a single truck equipped with two W. P. 30 motors. The other car was a giant, 40 feet long with a double truck, each equipped with a W. P. 50 motor. The floor of this was removable, to enable the operation of the apparatus to be seen. Recording instruments showed how much energy was required to operate the cars. It is such cars as these that mark an epoch in the street railway era.

The headquarters of the company at the "Hollenden Hotel" were most tastefully decorated with shrubs, ferns, plants and flowers, and hung with photographs setting forth the exploits of the General Electric Company. Mr. W. J. Clark, the general agent of the Railway Department, in whose hands the entire management of the General Electric Company's exhibit was placed, acted as host, and his geniailty and cordial greeting of all the visitors won for him the good-will of every one at the convention. Mr. Clark was ably seconded in his efforts by Mr. Elmer P. Morris, of the Railway Supply Department; Mr. G. K. Wheeler, assistant manager of the Chicago Railway Department; Mr. F. J. Clark, manager at Washington; Mr. H. H. Harrison; Mr. C. S. Rusling: Mr. I. Silverman; Mr. W. A. Stern, and a thoroughly competent staff of General Electric Company's men.

The General Electric officials on the ground were: O. T. Crosby, W. J. Clark, G. K. Wheeler, Paul T. Brady, F. H. Clarke, C. S. Rusling, W. H. Knight, E. W. Rice, Theo. Stebbins, Arthur W. Jones, A. A. Glazier, Caryl D. Haskins, John McGhie, Geo. W. Mansfield, E. G. Waters, W. A. Stern, H. H. Harrison, C. E. Hart, A. H. Lewis, T. H. Fearey, R. J. Randolph, R. H. Strieby, C. T. Hamilton, F. E. Jackson, F. E. Allen, S. P. Wells, C. R. Stearn, Percy Hodges, T. F. Mullaney, M. H. Hamilton, J. A. Kimball, H. S. Elliott, —— Ewing, F. H. Bostwick, B. M. Barr, F. Houghton, G. H. Stout, E. P. Sharp, W. B. Potter, G. H. Alton, —— Woolsey, R. E. Hood, Geo. M. Haskell, F. J. Reynolds.

The Technical Press was well represented. *The Street Railway Journal* had handsome headquarters, with electrical effects, and distributed a most beautiful and interesting souvenir of Cleveland, describing the electrical and other railway industries of the cities, and giving views of its most beautiful buildings and resorts. The souvenir is certainly something to be proud of. The *Street Railway Gazette* distinguished itself by publishing its regular issue in Cleveland, so as to dodge the Columbus celebrations in Chicago, and thus avoid delay. The *Street Railway News* made a hit by issuing a neat daily bulletin.

The Detroit Electrical Works were ably represented by Jos. E. Lockwood, secretary, and L. E. Myers, who holds down Chicago with the help of the Monadnock Building. A graceful compliment was paid Mr. Lockwood in placing him in the chair at the important meeting of the supply men on Wednesday evening, when it was proposed to organize an association. The proceedings were of the most picturesque character, and there was plenty of chance to allow unparliamentary scenes, but Mr. Lockwood ran things in an easy, masterful way, and pleased everybody.

The Edison Manufacturing Company had a mighty name to conjure with, and their new Edison electrostatic voltmeter, shown in Army and Navy Hall, by Mr. E. M. Smiles, attracted very general attention. It has a very considerable advantage for station and power house work in the fact that it can be placed in close proximity to the generators and is wholly undisturbed. The mechanism is very simple and easy of adjustment. The scale is very legible and can be made out several feet away.

J. H. Bunnell & Co. were represented by Messrs. C. McLaughlin and J. J. Ghegan, who gave evidence of a keen appreciation of all the latest advances in the art. Mr. McLaughlin is a director of the Paterson, N. J., electric road, and being also a large electrical manufacturer, he is in a peculiarly favorable position to know the good qualities of new railway methods and apparatus. After taking in the convention, this Bunnell contingent moved on Chicago.

The Interior Conduit and Insulation Company were represented by C. A. Benton, who had many interviews on the subject of putting in their conduit for railway feeders. Mr. Benton also found a great many men who had heard of the Sprague electric elevator, for which he is the special agent, and who knowing Mr. Sprague's magnificent record in the railway field, are ready to accept his elevator as no less distinct an advance.

Kuehnle Trolley Wheel. A peculiar and apparently desirable improvement in trolley wheel construction was shown by Mr. John Kuehnle, of Detroit. The hub is composed of roller bearings, one roller being filled with powdered graphite feeding automatically on the axle. Great advantages are claimed for this wheel, and it is at least an ingenious device.

Mr. Wm. Taylor, of Taylor, Goodhue & Ames, Chicago, made his first appearance at a convention as president of this newly organized railway specialty company. He reports having secured the Western agency of the Philadelphia trolley, Wagner motors for street railway circuits, the Columbia incandescent lamp, and the Nutting arc lamp, both of which are for use on street railway circuits.

A Three-Ply Leather Belt, 116 feet long and 6 feet wide, was one of the first exhibits that met the eye upon entering the hall. It was made by the Chas. A. Schiern Company, of New York, for the Brooklyn City Railway, and weighs 2,200 lbs. Chas. A. Schieren, Jr., and Mr. E. P. Atkinson looked well to the interests of the company. Their perforated electric belts were also exhibited.

The Cleveland Electric Manufacturing Company were represented by Mr. R. B. Williams. They are agents for the Indiana Rubber Company and of course there were some reels of "Paranite" visible. They are also agents for the Standard Electric Time Company and manufacturers of the American watchman's time detector.

Electric car heaters, also office and dwelling heaters, were shown and some excellent results given by the Dewey Electric Heating Company. Mr. E. B. Wyman, general manager, and Mr. M. W. Dewey entertained the curious. These heaters were recently described in The Electrical Engineer.

Mr. C. O. Mailloux, the electrical engineer, was at the convention, and answered many questions as to his automatic load equalizer. It may be truly said that the whole country watches with interest his results with storage batteries on the Metropolitan Road in Washington.

J. A. Ferguson showed the Shultz Belting Company's patent sable rawhide belt and the patent leather pulley cover manufactured by this company. They have just completed a 132-foot 54-inch belt for the Union Depot Electric Railway Company, of St. Louis.

Daniel Coolidge, Johnstown; Major H. C. Evans, New York; W. E. Boughton, Philadelphia; W. B. Kingston, Atlanta, Ga., and O. C. Evans, Cincinnati. This list of names means the Johnson Company, of Johnstown, Pa. No further mention necessary.

There is only one Supply Manufacturing Company. They are at 100 Wood St., Pittsburgh, and their commutators are the only ones made of Eureka tempered copper. Moral. R. R. Hammond lost no chance to explain all this to those interested.

The Electrical Engineer was represented by Messrs. F. R. Colvin, T. C. Martin, L. W. Collins, and Mr. Willson, its Cleveland correspondent. It had two large rooms for headquarters, and distributed several hundred copies of its current issue.

C. H. Smith, of Troy, N. Y., showed an ingenious and simple device which should at least appeal to the employees on electric cars; his trolley finder should be a *finder* of great favor. His changeable signal box was also interesting.

Mr. J. D. Elwell, Mr. H. S. Carghill and Mr. S. Russell, Jr., had an interesting exhibit of their Duplex street railway track. This was a most interesting exhibit to all directly interested in street railway work.

J. W. Godfrey.—Well, that means New York Insulated Wire every time. The interests of the New York Insulated Wire Company are always well taken care of in the hands of their general manager.

A most desirable feature pursued by the General Electric Company in presenting their souvenir book was the printing in gold of the name of the recipient on the handsome morocco cover.

Frank A. Magee had an interesting exhibit of the E. S. Greeley Company's railway specialties, test instruments, etc., notable among which was the celebrated Duggan trolley bracket.

Mr. F. B. Rae.—A street railway convention without the familiar form of F. B. Rae would be a strange thing and of course he was at Cleveland. His many friends were glad to see him.

"A. B. C." had their interests at the convention entrusted to Mr. H. G. Issertel, manager of the railway department. It is needless to say they were well looked after.

John A. Roebling's Sons Company had Mr. H. L. Shippy and Capt. Sparling as representatives.

The Johnson Electric Co., manufacturers of electric railway supplies, showed a fine line of samples in Army and Navy Hall. J. J. Coleman was there in the interest of the company.

Louis McCarthy, treasurer and general manager of the W. T. C. Macallen Company, of Boston, showed their solid mica insulators.

Mr. Hollis French was there in the interests of his company, the Massachusetts Electrical Engineering Company.

The Short Electric Railway Co. did the honors for Cleveland in a manner beyond all reproach, and were most ably represented by Messrs. Short, Potter, Hazleton, Curtiss, Wessels, Scheffler and others of the staff, aided by Messrs. Phipps, of the Brush Works, and Professor Roberts, of the Swan Lamp Mfg. Co. At the Hollenden House, beautifully decorated parlors were occupied on the first floor, where the tasteful literature of the company was freely dispensed, with souvenirs of all kinds for the delegates and their wives. There were also shown lighted Swan lamps embedded in ice and other egg lamps nested under graceful swans. On Wednesday afternoon, on a train of Short cars run down to the hotel over a track built for the occasion, the convention went en masse to the factory, where they were graciously received by Prof. Short, Mr. Potter and Mr. Hazleton, and not only entertained with a sumptuous luncheon but escorted all over the works so that they could see for themselves the new Short gearless in process of construction. In the Swan lamp works, Prof. Roberts showed the visitors how lamps are made, and a pretty lamp-vase souvenir, made out of a lamp bulb was given to the ladies. The masculine contingent received dainty leather pocketbooks containing a variety of most valuable electric railway data. Many trips were taken on the gearless cars, under the charge of Mr. Curtiss and Mr. Wills, and all the electric railway plants were visited, a warm reception being given at all of them.

The Short Company also had a fine exhibit on the stage of Army and Navy Hall, of their motors, generators, and detail apparatus under the care of Mr. C. F. Uebelacker and a large corps of assistants.

The Ford-Washburn Storelectro Co., of Cleveland, made a most interesting exhibit of their storage battery in Army and Navy Hall, under the charge of Mr. Washburn. The battery was shown complete, and in parts, charged and uncharged. The storage battery car was also actively on exhibition and was freely utilized in making trips around the city, where it attracted the utmost attention from the delegates and the public. The car was run with the instruments on, so that everybody could study the consumption of current. It is greatly to be regretted that the storage car was in a small minority at Cleveland, but if it goes on making such records as this car does, it will soon occupy a much larger place. The Ford-Washburn people have a good thing, and the convention at Cleveland must bring their battery to the front.

Among the notable features of the Hirt six-wheel radial truck exhibited at Cleveland last week, were the wrought iron castings used on these trucks for clamps, jaws, and other parts where great strength and toughness are necessary. They were made by the Wrought Iron Casting Co., of South Boston, Mass., who are doing a large business in this line of work and also in dynamo and motor castings.

Mr. Ludwig Gutmann made an exhibit at the Brush electric light station, through the courtesy of its manager, Mr. Sam. C. D. Johns, of his new alternating current motor in fan sizes. The motor is of simple and inexpensive construction, and takes very little current, runs cold and quietly, and is very pretty to look at. It is destined, in our opinion, to a very wide use.

Mr. W. E. Irish, a well-known Cleveland electrician, was in attendance, and took many friends to his laboratory, where they saw his new sectional conduit railway system and his very simple new arc lamps for alternating and direct current.

The Genett Air Brake was exhibited by Mr. David Reid, the Chicago agent of the company. This novelty is a conspicuous bidder for popularity, and a most desirable one too. Simplicity and a positive brake are its features.

H. P. Barr, secretary and treasurer, exhibited for the first time the new Sperry electric railway system. Mr. Elmer A. Sperry, the inventor, was also on the ground. Theirs was a particularly interesting exhibit.

Capt. Willard Candee, of the Okonite, and Mr. H. D. Stanley, who has but recently connected himself with this company, were there. Okonite interests could not possibly suffer in the hands of these gentlemen.

Billings & Spencer. Arrangements were so made that the Connecticut contingent grouped their exhibit. F. G. Billings showed a sample board of their commutator bars and drop forgings.

Mr. Reimond, president of the Mosher Arc Lamp Company, spent a day or two at the convention. This company have recently received some very flattering orders for their arc lamp.

The Ahearn Electric Heater was one of the exhibits of the Railway Equipment Company. Mr. Soper and Mr. Dewar, of Ottawa, were in attendance.

J. G. White, the electric railway contractor, New York, interested many of his friends in reports of new construction work in hand.

The Westinghouse Electric and Mfg. Co. made an extremely effective exhibit, not of the brass band order but rather that of the still small voice kind. Their headquarters were in a large room off the main entrance to the Hollenden, and were plentifully supplied with pictures, pamphlets, photographs, etc., all relating to Westinghouse apparatus. The company was represented by the following gentlemen:

Lemuel Bannister, vice-president and general manager; W. C. Clark, general agent, assistant treasurer; Albert Schmid, general superintendent; H. McL. Harding; W. F. Zimmerman, assistant general manager; A. J. Wurts, electrical engineer; J. A. Rutherford; T. W. F. Gray; R. S Brown; A. L. McCarthy; E. L. Ludwig; G. Pantaleoni; A. S. Stewart; E. R. Bragg; H. Franz; T. N. Waterman; Antoni Gonet; W. J. Longmore; E. H. Heinrichs.

The exhibit in Army and Navy Hall, included two 25 h. p. railway motors on truck, one 25 h. p. in separate parts; a switchboard with voltmeter, ammeters, lightning arresters, circuit breakers, switches, etc.; a tank lightning arrester; non-arcing arresters for alternating circuit; street car fuse blocks; multiple series controlling devices, etc. There was also shown a fine group of Westinghouse cars on Woodland avenue, which were freely used, and which elicited frequent, well-deserved encomiums from veteran electric railway men, on account of the simplicity, high finish, light consumption of current, etc.

The Washburn & Moen Co. showed a most complete line of samples of their insulated wire, particularly a section of their 2,500,000 circular mils insulated cable, this being the largest cable ever insulated. They also showed a sample of a 500,000 circular mils cable, of which 35 miles have been sold to the new Brooklyn Electric Railway Co. The famous Salamander wire test was very interesting. This test was made by Mr. Snedeker, the patentee. It thoroughly proved that the insulation is perfectly fireproof. To make this test it was necessary to put another interesting exhibitor's goods to a most severe test, and that was the repeated short-circuiting of a Ford-Washburn Storelectro Company battery. This was done repeatedly without doing the least harm.

A special railway lamp was shown by Mr. Jackson, from the Edison lamp works of the General Company. It is intended to be run in groups of five, at 16 and 30 c. p. The filament is thick, but when uncoiled would be longer than the ordinary one. The glass envelope is also made shorter, having practically no neck. The lamp as now made is for interior use but it is also to be made waterproof. It fits all the old Edison, and Thomson-Houston railway sockets.

The Charles Scott Spring Co., of Philadelphia, made a most interesting exhibit of their spiral and elliptic springs for trolley and motor use. Their springs are made for all standard trucks. The company were well represented by Mr. Chas. Scott, Jr., and Mr. H. C. Johnston. The springs of this well-known company are in almost universal use and are giving excellent results. A very handsome souvenir was distributed.

Jewell Belting.—A display of Jewell belting was well looked after by Mr. C. E. Newton, secretary; Mr. G. W. Bancroft, general sales agent, and Mr. C. L. Tolles. They showed, among other things, a very fine double 48-inch generator belt, made for the General Electric Co., New York. A handsome souvenir was eagerly sought.

The Railway Equipment Co. was represented by Mr. W. R. Mason, general manager; W. L. Adams, C. S. Bowe, J. F. Macartney. They had parlor headquarters in the Hollenden, as well as an interesting exhibit in the hall.

Mr. W. F. D. Crane represented the H. W. Johns Co. and showed some interesting samples of molded mica insulators, storage battery plate separators, switch-bases, cut-out blocks, and sockets in their special product, *black mica.*

A convention without P. C. Ackerman would be lacking a great deal. This, however, does not occur, as he is always there, and the American Electrical Works interests are in good hands.

Mr. J. B. Allan, general agent of the Edward P. Allis Co., of Milwaukee, was on the ground and did the proper thing for the Reynolds-Corliss engine.

The Carpenter Enamel Rheostat interests were personally taken care of by Mr. C. E. Carpenter. They had an interesting exhibit of their products.

"Ajax" Van Nuis was there with his switches and Fulmen lightning arresters. The arresters made an interesting souvenir.

The Field Engineering Company, New York, was represented by its popular president, Mr. C. J. Field, M. E.

J. A. Hanna and D. B. Dean were kept busy telling the good points in the well-known McGuire truck.

Messrs. Baird and Newton, of the Eddy Motor Company, were on the ground.

The Eureka Tempered Copper Co.'s exhibit was tastefully displayed on the second floor of the Army and Navy Hall, and was in charge of Mr. Jno. R. Coffman and Mr. J. R. Phillips. Next to this exhibit was that of the Supply Manufacturing Co., an item regarding which appears elsewhere. As the very handsome and well-finished commutators of this company are all made from the Eureka Tempered Copper Company's product, the combined display of tempered copper was well worth seeing, and naturally attracted much attention on the part of the delegates and visitors. Some idea of the scope and magnitude of the E. T. C. Co.'s business may be gathered from the fact that they are now turning out over 5,000 different patterns of commutator bars and segments. Five hundred of these are turned out for the General Electric Company and Westinghouse Electric and Mfg. Co. A few attempts have been made by other parties to manufacture tempered copper by the use of an alloy; as an evidence that the E.T.C. Co. have to-day the only absolutely pure tempered copper on the market, they expressed their willingness at the convention to forfeit $1,000 in cash could any pure tempered copper other than their own be produced or exhibited. At the close of the convention the offer still remained open without a taker. This company is now ready to move into the new extension to the works. The capacity of the company has already been several times increased, each extension being larger than its predecessor.

Mr. George H. Bryant showed the Bryant metal saw, manufactured by the Q. & C. Company, of Chicago. This is a most interesting device, and would seem an almost indispensable acquisition to street railway track laying where so much cutting of rails is necessary. It is perfectly automatic, easily fastened to the rail it is cutting, and will cut any angle. Many interested ones watched its easy meanderings through the hardest of chilled steel rails.

Mr. F. B. Brownell, of the Brownell Car Company, of St. Louis, had with him one of their remarkable "Accelerator" cars which have a most extraordinary capacity for unloading quickly by means of their double doorways and large platforms. It certainly looks as though they solved the problem of picking up large numbers of passengers quickly and putting them down with equal rapidity.

The Goodrich Hard Rubber Co., of Akron, Ohio, were represented by Mr. C. B. Raymond. Even now they have a large demand for hard rubber magnet heads, keys, knobs, window tubes, etc., but they know there is a right down good time coming with the approach of storage battery traction, when their hard rubber specialties will be more than ever in demand.

Alex. Lewis, so well known throughout the West from his connection at Cincinnati and Chicago with the Thomson-Houston and Edison General Co., and now holding a prominent position in the New York office of the Railway Department of the General Electric Co., received a right royal reception from a host of friends.

The Fulton Foundry Co., of Cleveland, were represented by Mr. W. E. Haycox, manager of the Street Railway Department, and Mr. C. J. Langdon. They showed a very fine motor and trailer truck, also a novel brake shoe with interchangeable slippers and the Lyons patent brush holder for railway motors.

The Partridge Carbon Co., of Sandusky, Ohio, displayed a full line of dynamo, motor and generator brushes, for the excellence of which goods this company is celebrated. Messrs. Partridge and Speer were both in attendance.

Gilbert M. Smith, Chicago, did good work at the convention for the Aluminium Brass and Bronze Co. Their souvenir was a paper weight (featherweight) of aluminum. Some one should stick a pin in this if it is a joke.

H. M. Loud & Sons Lumber Co., of Oscoda, Mich., showed octagonal poles for electric railways, and were glad to find their customers "loud," also, in praise of these trim pieces of construction material.

Mr. A. H. Englund, secretary and manager of the International Register Co., of Chicago, showed very handsome samples of their cash register.

The Western Electric Co., New York and Chicago, were on the ground with a miscellaneous line of supplies.

Mr. C. E. Bibber showed the Lyons break for the Consolidated Electric and Manufacturing Co., of Boston,

A special railway fuse, made by the Shawmut Fuse Wire Co. was shown by Mr. S. B. Condit.

Mr. Miller, of Pierce & Miller, sounded the praises especially of the McIntosh & Seymour engines..

E. Peckham showed one of his celebrated cantilever trucks, and his cushioned motor wheels.

W. H. Peck & Co., of Cleveland, showed samples of railway supplies and rubber goods.

Mr. J. L. Barclay attended the convention all through.

The J. G. Brill Co. have their cars and trucks so largely in use, that an exhibit was hardly needed, especially as the Woodland Avenue line in Cleveland has Brill cars for its Westinghouse system. But the company did not neglect the regular exhibition, in Army and Navy Hall, and showed there several handsome models of its special and well-known trucks. At the same place, the General Electric Company also showed one of the new Brill trucks with W. P. motor equipments. There were on the ground Messrs. J. G. Brill, Jr., Payson K. Andrews, F. C. Randall, W. H. Hulings, and Curwin.

New Process Raw Hide Co.—An interesting exhibit indeed was that of the New Process Raw Hide Co. A. C. Vosburg, secretary; T.W. Meacham, president, and J. C. Kenyon, treasurer, were in charge. They showed a number of samples of their rawhide gears and pinions. The special part of the exhibit was a motor pinion taken from a Sprague No. 6 motor, having a record of 22,000 miles on the West Bay City electric road. It is still in excellent condition and fit for as many miles more.

R. B. Corey, manager of the Electric Construction and Supply Company, was at the convention. It is needless to say that the famous "Ward Lamp" was the text for most of the interesting conversations which we found him engaged in. These lamps are in such general use in Cleveland that it was scarcely necessary to have a sample on exhibition.

The Standard Paint Company were admirably represented by Mr. P. H. Hover, from Chicago. The company have a large factory in Cleveland and are just opening another big one at Bound Brook. Their P. and B. compound is known as an indispensable auxiliary to the business.

Simplex.—It is unnecessary to say that the interests of the Simplex Electrical Company, of Boston, were well taken care of in the hands of General Manager J. H. Mason and Assistant Manager Major D. T. Everts. No opportunities were lost by either gentleman to say a good word for Simplex.

Mr. J. A. Tackaberry and Mr. D. W. Pugh lost no opportunity to say a good word for the John Stephenson cars. Their task was an easy one as the mere mention of the name John Stephenson is a spell and charm. They are again presenting a handsome memorandum book.

R. D. Nuttall Company showed a full line of electric railway supplies and specialties, including their raw-hide motor pinions. Messrs. R. D. Nuttall, W. C. Groetzinger, C. J. Mayer and P. H. Corey, Chicago, represented this enterprising firm.

Garton Lightning Arrester.—An ingenious device was the Garton lightning arrester. It was shown by Mr. Garton, of the Garton-Daniels Electric Company, of Keokuk, Iowa. Absolute protection is guaranteed to all railway apparatus.

The Graves Arc Lamp.—It was bright as day in the pavilion from dark until sunrise, as fifty Graves arc lamps were distributed about and above the different exhibits. They did themselves and their manufacturers credit.

The Babcock & Wilcox Company, New York, were represented by Messrs. J. A. Taft, P. B. Hayette, S. H. Scovel and W. C. Temple. They distributed their beautiful work on "Steam."

The Robinson Radial Truck Co. took excellent care of the delegates by placing car No. 250 at their disposal, and by issuing a complete time table for its trips morning and afternoon.

Secretary Geo. C. Shepard, of the Brightman Stoker Company, was kept busy explaining the many good points of their mechanical stoker to an interested audience.

G. M. Angier did good work for the Mather Co. Mr. Angier has a host of acquaintances in the business. His many Western friends were glad to renew old times.

G. H. Herndon said many good things regarding the Brightman mehanical stoker. This was a most interesting exhibit in operation. It must be a money saver.

Lamokin Car Works, of Chester, Pa., were ably represented by Superintendent Henry Cochrane and Mr. G. E. Pratt. They had one of their new cars running.

The Walworth Manufacturing Company, of Boston, were on hand and made a fine showing of their universally-known iron poles.

The Griffin Car Wheel Company, of Chicago, were on the ground and showed several of their particular line of wheels.

A small section (working) of the Combination car of the Combination Car Company, of Boston, was of great interest to many of the visitors.

The Safety Brake Shoe and Construction Company, of Boston, showed samples of their ingenious brake shoe.

O. W. Mysenburg & Co., Chicago, were represented by the genial W. A. Littlefield.

The Rochester Eureka Wood Filler Co. are placing on the market a most desirable wood filler for use in car building. It works perfectly on oak, ash, walnut, birch, cherry or mahogany; in fact, on any wood at present used by street car builders. It is the only liquid filler that can be used on oak or ash with guaranteed success. It can be used over water or vegetable stains to bring out the color. This company also manufacture a substitute for shellac that should be interesting to car builders. It is used extensively as a filler, and it can be sandpapered easily inside of one hour after it is put on. This particular article can be supplied at a much less cost than any similar article at present on the market. Being manufacturers, this company have on hand at all times a large stock of liquid and paste fillers, car varnishes of excellent quality, and, in fact, all kinds of finishing material. Persons needing anything in this line should at least write the company for samples and prices. Their address is D. R. McKissick, secretary and treasurer, Rochester Eureka Wood Filler Co., Rochester, N. Y.

Mr. R. S. Bishop, of the American District Steam Company, of Lockport, was at the convention embracing the excellent opportunity to place before the street railway people the theory of, and the system his company has for, the sale of exhaust steam for heating stores, dwellings, warehouses, etc. Mr. Bishop not only reports a number of new plants sold to electric light and power stations, but, reports that the exhaust steam plant sold to the Springfield, Ill., electric light station has proven so satisfactory and such a profitable investment to the residents that a considerable extension of the system has been undertaken; this it is expected will be completed by the end of the present month.

Johnston Disconnector.—A decided improvement has been made in the Johnston automatic safety disconnector for railway circuits. This improved device in its original form has been illustrated and described in The Electrical Engineer. Mr. F. B. Jacobs, secretary and treasurer of the company, and Mr. W. A. Cullen, superintendent of construction, were kept busy explaining how it was possible to take an apparently live wire in their hands without the least danger. Their device is being installed on the lines of the electric road at Paterson, N. J., and some interesting reports may be expected.

C. S. Jones, vice-president, H. E. Brown, secretary and treasurer, and F. B. Perkins, electrician, were at the convention in the interests of the Toledo Electric Heating Company. This is the maiden exhibit of this heater, and it evoked considerable interest. Several points as to economy, simplicity and especially durability for street car work are claimed. The company will make arrangements with parties desiring to handle their heaters in the West and in New York.

Mr. H. Ward Leonard was on the ground in the interests of H. Ward Leonard & Co., who are to-day constructing one of the most interesting electric roads in the country; that which Mr. T. C. Frenyear, who was also present, has organized between Johnstown, Fonda and Gloversville, in this State. It will be a passenger and freight road and will handle a heavy goods traffic. Mr. Leonard also assisted Mr. Carpenter in explaining the merits of the Carpenter car rheostats.

The Walker Manufacturing Co. had a large exhibit and a host of representatives in attendance. A pleasing event of Friday morning was a carriage ride to their extensive works in West Cleveland. About 300 delegates availed themselves of this opportunity to visit these wonderful works, created by American enterprise and the growth of the cable industry.

Mr. Lodge and Mr. Shepley, of the Lodge & Shepley Machine Tool Company, of Cincinnati, were both in attendance and showed a most novel motor gear lathe, which bores, turns and squares a motor gear all at the same time. Sales of this machine were made to R. D. Nuttall (1), Johnson Electric Co. (2), West End Street Railway Co. (1).

Mr. Walter C. Kerr was present in the interests of Westinghouse, Church, Kerr & Co., who have been putting in some very fine electric railway plants lately, from some of which, such as those at Biddeford, Me., and New Haven, Conn., an extraordinarily high efficiency has been obtained.

Mr. M. M. Wood and Mr. C. K. King were at the convention looking after the welfare of the Electrical Supply Co. They showed a line of specialties for overhead construction and of course did considerable talking on the merits of the Carpenter Electric Street Car Heater.

Wm. Wharton, Jr., & Co., of Philadelphia, were represented by Mr. W. Wharton, Jr., president; Mr. F. P. Home, second vice-president; Mr. Robert McCloy; Mr. A. W. Slee, Western sales agent, St. Louis; Mr. J. C. Robinson, New England agent.

Mr. H. L. Lufkin was in the city during the convention, attending to other important business for the C. & C. Electric Motor Co., but not neglecting his opportunities in the street railway field.

Sargent & Lundy, Western agents of the McIntosh & Seymour engines, and power plant contractors, had their interests in good hands. Mr. A. C. Harrington represented them.

Col. J. H. Shay, better known to electrical people as the "electrician" of the Munson Belting company, renewed many an acquaintance. The colonel rarely misses a convention.

The Van Dorn Street Car Coupler was a little device that attracted a great deal of attention. It is a very simple automatic coupler, now in use in Milwaukee and Fort Wayne.

The Cleveland Electric Manufacturing Company had an exhibit in the hall. Mr. F. J. A. Keller and Superintendent C. A. Dainz were on the ground most of the time.

The Duncan Trolley was explained to visitors by Mr. A. P. Manning; special points in this trolley are a large compressed spring swivel base and an automatic oil feed.

Mr. G. Herbert Condict, of Philadelphia, talked so hopefully of storage battery traction that it is believed he must have his eye on some important project.

W. Bingham was represented by Mr. C. E. M. Young, and showed an interesting line of street railway headlights, etc., and a remarkable hydraulic motor lift.

Without doubt one of the busiest men at the convention was Elmer P. Morris. The railway exhibits of the General Electric Co. were in excellent hands.

The Bradley Electric Railway Conduit Company showed a full size section of their system, Mr. Bradley explaining the desirable features.

L. H. Elliott, secretary, and A. J. Wright, president of the Reliance Gauge Co., showed a number of their guages and water columns.

Mr. W. A. Hathaway, of the American Electrical Works, made a flying trip from Boston to Cleveland to attend the convention.

E. Packer and F. W. Russell, of the Rochester car wheel works, were also there. They had a most interesting and complete exhibit.

Mr. John Taylor, of the Taylor Truck Company, of Troy, N. Y., showed a very handsome car truck manufactured by his company.

The Celebrated Chapman Valve was there on exhibition; the interests of the company were taken care of by Mr. E. L. Ross.

H. T. Paiste had his new self-oiling trolley wheel with adjustable contact with him to interest his many friends.

The "Nonesuch" Fibre Company, of Wilmington, Del., had Mr. W. L. G. Thomas at the convention in their interests.

E. Webster, of the Stilwell & Bierce Manufacturing Company, was at the Hollenden during convention days.

The Dayton Mfg. Co., of Dayton, O., was represented at the convention by Mr. P. Leidinger and Mr. Jos. Leidinger.

Hill Clutches hardly need mention, because S. S. Leonard told every person at the convention about them.

A Novel Rail Joint Tightener was shown by Mr. C. W. Pope, of the J. L. Pope Company.

The Perkins Lamp Company had Mr. C. J. Hill on the ground, looking after their interests.

F. M. Laughlin and H. E. Webb were there and talked Solar carbon to good advantage.

Warren Webster & Co., of Philadelphia, were represented by Mr. Wm. M. M. Candless.

Messrs. Pepper & Register, of Philadelphia, were represented by Mr. A. L. Register.

C. S. Knowles, of Boston, was represented at the convention by Mr. J. H. Parker.

The Sterling Boiler Co., of Chicago, was represented by Mr. F. E. Bruce.

Mr. Edw. P. Sharp represented the American Mica Company of Boston.

J. S. Pugh said many good things about the Baltimore car wheels.

The Annual Banquet was given on Thursday evening at the Hollenden, and was presided over by Mr. McLean, first vice-president. Among the speakers were: Mr. D. F. Longstreet, of Denver, the new president; Tom L. Johnson, and Wm. J. Richardson, of Brooklyn, the Nestor of the association, who contributed some most interesting memories of Cleveland, 58 years ago.

The Duplex Street Railway Track Company gave a récherché dinner on Wednesday, at the Stillman House, to John G. Holmes, president of the American Street Railway Association, Mr. H. H. Littell, founder and first president of the American Street Railway Association, and Mr. Henry Watson, ex-president of the American Street Railway Association. The Duplex Company was represented by Mr. John D. Elwell, Mr. H. L. Cargill and Mr. S. R. Russell, Jr. Other guests were John N. Beckley, president of the New York Street Railway Association; Mr. Charles Cleminshaw, Judge Kent, of Troy; M. H. Littell, L. Perrine, T. H. McLean, secretary of the Sixth Avenue Railway Company, New York; H. McL. Harding, O. T. Crosby and Mr. J. G. White, of New York. The distinction of the guests, and the taste with which the dinner was served in every respect, made the affair one of the leading events of the convention. The Duplex track is a well-known improvement now, and is in such strong and respectable hands that it has become a leading bidder for patronage in the rail department of the industry.

A Luncheon to the Ladies.—The wives of the delegates and other ladies brought to the city by the convention were the guests of Mrs. S. H. Short, on Thursday afternoon. A special excursion was enjoyed in the elegant private Short cars, which were placed at the disposal of the visitors. The route was out Euclid avenue to the Garfield Memorial, the return trip being made by way of Cedar avenue. The objective point of the return trip, however, was the Union Club, where a bountiful luncheon was given by Mrs. Short. The table was tastefully decorated with flowers, yellow being the prevailing shade. The affair was a most enjoyable one, adding not a little to the pleasure of the day. The guests numbered twenty-eight.

SOCIETY AND CLUB NOTES.

THE NEW YORK ELECTRICAL SOCIETY.

At the meeting of the Society, held at Columbia College on October 19, Prof. F. B. Crocker made a very interesting address entitled "What Europe is doing in Electricity." In order best to convey to his hearers the nature of the practice abroad, Prof. Crocker pointed out the differences between foreign practice and our own, and the reasons which dictated such differentiation.

Beginning on the subject of scientific instruments, Prof. Crocker thought that we were able to produce quite as good instruments as those made abroad, and named several American manufacturers, who, he considered, were well able to compete with foreign makers. Except, perhaps, in special apparatus, or in such involving much hand work, in which, of course, they excelled us abroad, we were abreast of Europe.

The field of electric lighting, Prof. Crocker thought, presented the greatest differences in practice. Their work there was striking on account of the large scale and substantial character in which it is carried out, the employment of large units, especially on the continent of Europe, being the general practice. It was apparent everywhere that no expense was spared to make installations perfect, although Prof. Crocker thought that foreigners went a trifle too far in money spent merely for ornamental effects in their stations. While, on the continent of Europe large units involving direct connected slow-speed engines are employed most generally, the practice in England tended largely towards the employment of engines running at between three and four hundred revolutions per minute. Both these methods were distinct from ours, as it exists at the present day, in which belt connection is largely predominant.

Prof. Crocker also dwelt at length upon the employment of storage batteries in the central station, which he considered a necessary evil, and which could only be applied with any degree of economy to stations having a light day load. Even then, Prof. Crocker thought, a small engine kept in operation during the light load would prove more economical than an installation of batteries, which were expensive in themselves, and required large space for their handling. Throughout his recent tour abroad Prof. Crocker met with not a single case in which the battery was used to assist the engine during the heavy load period. The success obtained with storage batteries abroad was undoubtedly due to their solid construction, in contradistinction to our thin and flexible battery plates. Prof. Crocker, contrary to his expectations, found the fixtures and fittings abroad very substantial and neat.

Electric power, as embodied in stationary motors, is still a thing of the future abroad. While we have from fifty to one hundred thousand motors in America, Europe all told did not have more than a thousand in operation. The transmission of water power, however, in Switzerland was quite advanced, and in that respect probably exceeded our own. The plants are, as a rule, very successful. Contrary to an opinion which seems to prevail among many here, there are comparatively few three-phase systems of power transmission in operation.

European electric railways are still few, and as a rule copied from our own practice, and we have nothing to learn from abroad in this department.

Prof. Crocker also gave some account of the English telegraph and telephone service.

During his address the lecturer exhibited a number of photographs and samples of electric fittings brought from abroad, which served to illustrate his points. In the discussion which followed Messrs. Hammer, Strauss and Egger took part.

AN ELECTRICAL CONTRACTORS' ASSOCIATION IN NEW YORK.

It is understood that an Electrical Contractors' Association has been formed in this city by the concerns engaged in wiring and construction work, including such companies and firms as the Tucker Electrical Company; H. Ward Leonard & Co.; New York Electric Equipment Company; Zimdars & Hunt; Chas. L. Eidlitz; Western Electric Company; Rousseau & Co.; Edwards & Co.; Ostrander & Co.; Interior Conduit Wiring Company; J P. Hall; Bateman & Pollard; Hatzel & Buehler; Haggerty & Co.; Chapin & Co.; Eureka Electric Company; Interior Conduit and Fixture Company. This association will be a member of the United Building Trades Association, and its object is to secure greater freedom for the concerns belonging to it in the hiring of competent and faithful men, whether in the Wiremen's Union or out of it. Each of the members has posted a notice in its office stating that hereafter there will be no discrimination between men in the union or out of it. All labor will be hired simply on the ground of its quality. It is said that there are about 700 men in the Union and 400 outside, and that the proportion of really competent men is far larger in the non-union ranks than in the other group. This new departure has led to trouble already on work now in hand, but the Association claims that it is only acting after long consideration and that it will undoubtedly secure its purpose.

A COURSE OF LECTURES IN ELECTRICITY.

Mr. Elmer G. Willyoung, superintendent of Messrs. Queen & Co.'s. laboratory at Philadelphia, is delivering a course of lectures at the Young Men's Christian Association, Philadelphia, on Thursday evenings, which will continue until March 30, next. The lectures will embrace the science of electricity and its application to commercial uses, and are very exhaustive in their scope. They will be profusely illustrated, as Mr. Willyoung has at his command all the apparatus necessary for practical demonstration.

LETTERS TO THE EDITOR.

THE CONSTRUCTION OF UNIPOLAR MACHINES.

From a consideration of Mr. Steinmetz's theory that a revolving magnet would generate an electromotive force within itself, cutting its own lines of force, it follows, I think, that the field *would* revolve, owing to a resistance to this cutting.

Beyond accounting for the failure of Mr. Balch's second machine (which, I think, he misunderstands, for it was, I believe, Mr. Balch's idea to make the magnets hollow, that the inductor might be coiled through them, but with no electrical connection between the three) by the non-revolution of the field, Mr. Steinmetz says nothing.

What would occur were the fields made to revolve practically as by means of projections at the pole-pieces, he does not discuss, which is, to say the least, a disappointment.

Harold R. Wellman.

Duluth, Minn., Oct. 11, 1892.

COLLEGE NOTES.

COLUMBIAN UNIVERSITY, WASHINGTON, D. C.

The Corcoran Scientific School, of the Columbian University, includes among its courses, one of four years' duration leading to the degree of Electrical Engineer. In addition to the compulsory work in the department, a number of electives are provided, and a thesis is required before graduation. Prof. F. R. Fava, Jr., C. E., is in charge of this department.

JOHNS HOPKINS UNIVERSITY.

The course in electrical engineering will henceforth be accepted as part of the work leading to the Ph. D. degree in physics, and will be a most important and welcome change in the department. Work on the new electrical building is expected to begin within a month, and the structure will be ready for occupancy soon after the winter holidays.

LITERATURE.

Recent Progress in Electric Railways. By Carl Hering; 389 pages, 104 illustrations. New York. *W. J. Johnston Co., Limited.* Cloth, 12mo. Price, $1.

WE are informed on the title page of this curious book that it is "a summary of current periodical literature." If that were so, it would, indeed, be valuable. As a matter of fact, on turning over its pages, we find that the paper with which Mr. Hering has formed a casual connection is mentioned nearly thirty times. Two other papers, not electrical, are mentioned perhaps half a dozen times between them. Are we to understand that this is the author's idea of "current periodical literature," or are we to believe that he was under some malign influence which prevented him from realizing that there are more papers in the world than one? That the paper he most depended on could furnish him with a certain amount of clippable matter is no doubt true, but its pages are very far from embracing all the latest advances in electrical traction. If we look at Mr. Hering's preface we find further proof of the fact that his title page is inaccurate. We are informed that "the numerous electrical and other technical journals which give such a large amount of valuable information, must cover so many fields that their bound volumes are not convenient records in any one branch, besides being of necessity large and bulky, and therefore not handy, for connected reading or for subsequent reference." Hence the preparation of this volume and the promise of more like it. But we do not think that all electrical and technical journals come under this sweeping dispraise, although it may be quite true of the one Mr. Hering is understood to edit in spare hours—both as to its unwieldiness and as to the fact that it is not a good record to refer to. We are frank to say that we consider the form of THE ELECTRICAL ENGINEER peculiarly handy, and that its careful index, with cross-references to each half yearly volume, makes it very convenient for study in any branch of electricity.

Coming to the contents of the volumes, we find them divided up into twelve chapters. Now it would be supposed that if this volume is a record of "current" literature, it would have some recent starting point. But it has not. The very first chapter is entitled "Historical Notes," and like the address of the celebrated burgomaster in Offenbach's comic opera, it begins with "the year one ——." It informs us that in 1835-37, Mr. Frank L. Pope discovered Thomas Davenport. We always had a high opinion of Mr. Pope's ability, but this evidence of his precocity is quite startling. The truth is that last year Mr. Pope contributed to the pages of THE ELECTRICAL ENGINEER a very interesting series of articles on Davenport, but there is no such reference to our columns in Mr. Hering's book, although he is careful to drag in his own paper twice in three pages. Why he should handle historical data in such a way is best known to himself or his publisher. Moreover, the historical notes are not massed in this chapter, but crop up all through the book, and what makes this method of treatment the more confusing is that the book is entirely without an index!

The subsequent chapters deal with statistics, construction, operation, systems, accessories, etc., and appear to have been prepared chiefly with an abundant supply of mucilage and quotation marks, but with no attempt to give due sequence to the narrative. The result is very much that which would be obtained from reading a dictionary. One gets an idea that a great many subjects are touched on, but just what is coming next it is hard to guess. The effect is often grotesque. Papers read before the societies are sliced up and their paragraphs are dropped here and there from end to end of the book, in a "crazy quilt" fashion; so that we get expert advice; daily newspaper editorials; chance opinions; reports of tests; comments of the "compiler"; bits of old articles; and frequent references by page and date to the journal that Mr. Hering says is so unhandy for reading and reference—all mixed up in an olla podrida that only a strong stomach and a crude appetite could enjoy or digest. If anybody has a taste for this sort of thing, here is a great opportunity to indulge, but it is open to doubt whether the electrical public cares for such miscellaneous feeding.

Moreover, many of the citations are unfair and misleading. Thus on page 224 is a quotation from an interview with Mr. F. J. Sprague as to a tunnel system for New York. It is made to appear that this interview was had with a representative of the paper that Mr. Hering carefully names. As an actual matter of fact, the interview appeared in the New York *Commercial Advertiser*, which printed and circulated a special edition in order to forestall the journal named by Mr. Hering, in pirating the matter as its own for distribution at an electrical convention. The interview was given out to the various electrical papers on condition that they would not publish it until the following week, and all of them save one stood by their word.

We might go on and point out many other things in this book worthy of severe criticism, but our space is too valuable. We can only regret that Mr. Carl Hering was so ill-advised as to put his name to such a book, which is simply so much hash and mincemeat. He has done admirable work as an electrical author, and is capable of doing it again; but he should know that such performances as this cannot add to his well-deserved reputation. If it is necessary for somebody's pecuniary benefit that books of this nature must be ground out, let him leave it to men of lower ability. It is true that every electrical book must take more or less note of what the papers print, but brains and not scissors should be the editing implement. We cordially advise our readers to get Mr. Hering's other books, but to let this severely alone. Or if they must read, as they should, electric railway literature, they will find the pages of Crosby & Bell quite adequate to their current wants.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED OCTOBER 11, 1892.

Accumulators:—

Secondary Battery, W. L. Silvey, Lima, Ohio, 484,120. Filed Jan. 29, 1892.

Claim 8 follows: The process of making secondary battery plates which consists in mixing a metallic oxide with the liquid, placing the resulting product on a suitable support, subjecting it to the action of heat, then pickling it in a solution, and forming.

Alarms and Signals:—

Railroad Signal, E. Urbain, Brooklyn, N. Y., 484,068. Filed Oct. 20, 1891.

An electric automatic block signal system for steam railways.

Electric Fire Alarm, H. Cortland, Toronto, Canada, 484,140. Filed April 30, 1892.

Employs a thermostat adapted to first open and then close a circuit, and a clock mechanism for controlling the circuit.

Apparatus for Indicating the Positions of Railway Cars, J. H. Hunter, Pittsburgh, and J. S. Lucock, Alleghany, Pa., 484,205. Filed June 24, 1891.

Employs a chute divided into sections, balls representing the position of a car on its track, and electromagnets and circuit closers for controlling the movement of the balls in the chute.

Device for Preventing Accidental Closing of Electric Circuits in Signal Boxes, W. H. James, Boston, Mass., 484,206. Filed Feb. 16, 1892.

Provides means for preventing the closing of an electric circuit in the event of the breakage of the actuating spring.

Portable Burglar Alarm, D. D. Nolley, Wilson, N. C., 484,232. Filed May 25 1892.

Claim 2 follows: A burglar alarm comprising a battery, a bell, two contact points, one having two co-acting clamping arms for securing it to an object and the other having a screw and connecting wires.

Combined Electric Burglar and Fire Alarm, D. D. Nolley, Wilson, N. C., 484,233. Filed May 25, 1892.

Conductors, Conduits and Insulators:—

Electric Cable Splice, F. A. C. Perrine, Trenton, N. J., 484,045. Filed June 29 1891.

An unfilled cable splice having each spliced conductor surrounded by a sleeve of non-absorbent material, and having a casing outside the group of spliced conductors.

Insulator, F. M. Locke, Victor, N. Y., 484,209. Filed July 13, 1891.

Claim 1 follows: An insulator shank having one end pointed and threaded and the other end solid and channeled longitudinally.

Distribution:—

System of Electrical Distribution, H. W. Leonard, New York, N. Y., 484,208. Filed June 3, 1892.

Claim 1 follows: In a system of electrical distribution a combination of the main generator, the main lamp in multiple arc therewith, the low volt storage battery in series with the main lamps and the low volt lamps in multiple arc with said storage battery.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, J. W. Hoffman, Chicago, Ill., 484,096. Filed Dec. 12, 1891.

Employs a zinc cell provided with a plastic lining of starch and an excitant, a moistened filling of crushed coke or carbon, and a depolarizing agent, and a carbon plate embedded in said filling.

Battery Compound, W. Wright, New York, N. Y., 484,385. Filed Dec. 2, 1891.

Consists in subjecting sulphuric acid containing a metallic oxide and a chromium compound to a temperature of 275 degrees Fahrenheit for fifteen minutes, and then spreading it upon a plate cooled to 60 degrees Fahrenheit to become dry and granular.

Lamps and Appurtenances:

Apparatus for Regulating the Intensity of Incandescent Lights, J. F. McElroy, Albany, N. Y., 484,110. Filed July 30, 1891.

Employs an iron frame having an electric coil secured to it and an armature bent near its end in such a manner that the bended portion may be placed within the coil and the other end fulcrumed to the iron frame.

Manufacture of Carbon Filaments, T. A. Edison, Llewellyn Park, N. J., 484,184. Filed Oct. 27, 1886.

Consists in placing the bare filaments in a chamber together with a quantity of lead in unfused condition and exposing the same to carbonizing heat.

Manufacture of Carbon Filaments, T. A. Edison, Llewellyn Park, N. J., 484,185. Filed Dec. 27, 1886.

Employs a chamber for the reception of the filament receptacles and means for suspending said receptacles out of contact with the walls of the chamber.

Electric Arc Lamp, J. A. Hayes, Carson City, Nev., 484,199. Filed June 27, 1891.

A double-feed arc lamp designed for use in work where the light is to be focused.

Incandescent Electric Lamp Socket, C. J. Klein, New York, N. Y., 484,207. Filed Dec. 28, 1889.

Employs an elastic rubber ring surrounding the neck of the lamp and in contact with the edge of the socket.

Measurement:—

Electrical Depositing Meter, T. A. Edison, Llewellyn Park, N. J., 484,183. Filed Sept. 2, 1891.

Employs a ring electrode connected with a weighing apparatus, and a second electrode on two sides of the first electrode.

Miscellaneous :—

Range and Position Finder, B. A. Fiske, U. S. Navy, 483,999. Filed Feb. 13, 1892.

Claim 1 follows: The improvement in the art of finding the position of a distant object, which consists in first determining the fractional portion of a conducting body bearing in length a ratio to the angle of said object and, second, measuring the electrical resistance of said length.

Method of Electrical Refrigeration, M. W. Dewey, Syracuse, N. Y., 484,182. Filed Feb. 8, 1890.

Consists in lowering the temperature in a portion of a conductor and passing an electric current through the conductor to increase the conduction of heat from the warmer to the cooled portion.

Railways and Appliances :—

Electrically Operated Railway Switch, C. A. Stone, Newton, and E. S. Webster, Boston, Mass., 484,123. Filed Sept. 25, 1891.

Employ a pair of switch section conductors each connected through a magnet of the railway switch with the main electrical conductor, the trolley being adapted to make contact with either switch section conductor as desired.

Trolley Wire Insulator, A. Anderson, Boston, Mass., 484,280. Filed Dec. 23, 1899.

Employs an arch shaped frame supporting the insulator and having a channel at its upper side and pins at the lower ends. The span wire extends under the two pins and over the arch, being held into position by the channel.

Trolley Wire Cleaner, E. B. Smith, South Amherst, Mass., 484,344. Filed Feb. 26, 1892.

Employs a frame pivotally mounted at the end of the trolley pole and bearing a clearing device consisting of a hub having a central ridge and series of wings provided with openings.

Switches and Cut-Outs :—

Rosette, C. Wirt, Chicago, Ill., 484,077. Filed Aug. 29, 1891.

Employs circuit closers consisting each of a head cemented into recesses in the rosette cap, and having separated outer ends between and about which the local conductor may be twisted and secured.

Electric Switch, M. R. Utley, Minneapolis, Minn., 484,380. Filed March 5, 1892.

Employs a pivoted lever having contacts on its longer arm, and the upper portions of the end of its shorter arm rounded; a flat spring being arranged to bear against the end of the shorter arm to hold the lever in different positions of adjustment.

Telegraph :—

Railway Train Telegraph, M. S. Reiley, Washington, D. C., 464,375. Filed Jan. 4, 1888.

A railway telegraph employing a fixed conductor upon the bed of the road.

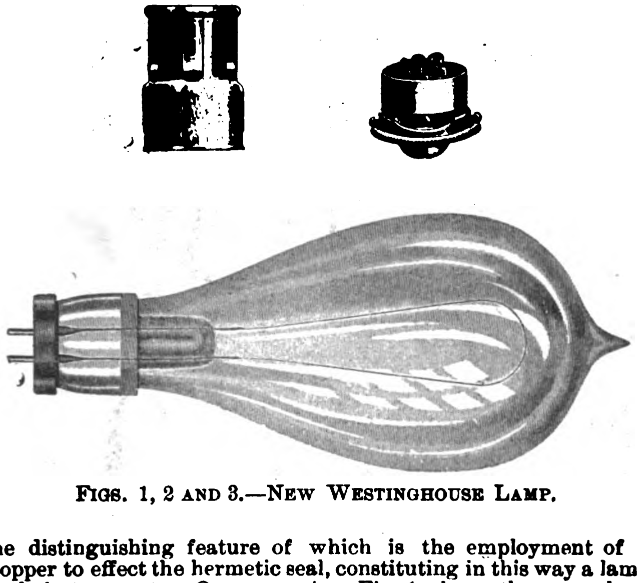
Telephones and Apparatus :—

Magnetic Telephone, C. S. Forbes, London, Eng., 484,150. Filed May 16, 1892.

Employs compound ringing magnets with soft iron pole-pieces carried by one end with a tympan box, and tympan and adjustable polar extensions each carrying an inducing bobbin filled with a conducting wire connecting the line and earth.

THE NEW WESTINGHOUSE LAMP.

As already announced in these columns, the Westinghouse Company propose shortly to place upon the market an incandescent lamp differing in construction from that heretofore in vogue, the distinguishing feature of which is the employment of a stopper to effect the hermetic seal, constituting in this way a lamp made in two parts. Our engraving, Fig. 1, shows the general appearance of the new lamp. The globe is blown separately, with a thick neck, which is ground to a perfect conical surface for the reception of the stopper. The latter, ground to correspond, has fused into it two stout leading-in wires, not of platinum, the ends within the lamp being reduced in size for the reception of the filament.



FIGS. 1, 2 AND 3.—NEW WESTINGHOUSE LAMP.

The stopper, with the filament mounted, is inserted into the lamp, which is then exhausted. Finally, a special cement is applied to the joint outside the lamp for the purpose of affording an added protection against air leakage.

The external ends of the leading-in wires act as the terminals which fit directly into the socket, shown in Figs. 2 and 3. The latter is extremely simple, the terminals being received by spring clips mounted on a porcelain base.

As the stopper holding the filament can be readily removed, the burnt-out lamps can be easily taken apart and new filaments inserted.

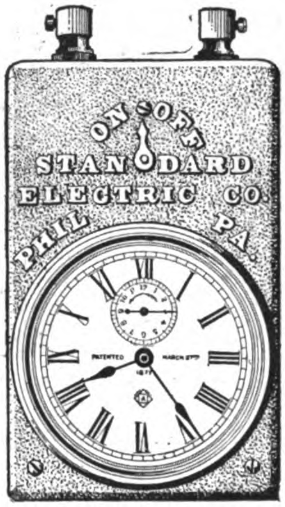
TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

It is a good thing to exhibit at conventions; it is a better to go in for systematic advertising.

THE "STANDARD" AUTOMATIC TIME CUT-OUT.

It is customary, for displaying or advertising purposes, to keep electric lamps burning after business hours, and it is desirable, for economic or other reasons, to cut out the lamps at an earlier hour than the time when the general supply circuit is broken at the central station; and in order to do this, the circuit must be broken at the point of consumption. To effect this automatically, the Standard Electric Company, of 2246 and 2248 N. 9th street, Philadelphia, Pa., have just brought out their "Standard" automatic time cut-out, which is illustrated in the accompanying engraving.



"STANDARD" AUTOMATIC TIME CUT-OUT.

By means of this switch the consumer is saved the annoyance and inconvenience of going himself or sending another person to the point of consumption in order to break the circuit. On account of the inconvenience of this proceeding, it is seldom done, and the consumer, who thus has his lamps in circuit two or three hours longer than he needs or desires them, is saved the additional expense of such unnecessary consumption of current.

With this automatic time switch in the circuit, in place of an ordinary switch, the consumer has merely to wind the clock work and set the "let-off" mechanism, so that it will be released at the desired time; he can then turn on the switch, and leave the device operate automatically. If, however, it is desired to turn off the current before the time determined upon, and perhaps to again complete the circuit, or if it be found desirable to turn on the switch and to turn it off again after the time switch has operated automatically, it can be done without any interference with the automatic mechanism employed in the switch.

ILLUMINATED DESIGNS IN THE COLUMBUS CELEBRATION AT CHICAGO.

The electrical design of the American and Spanish flags over the Grant statue at St. Louis, designed and erected by the Emerson Electric Manufacturing Co., and recently illustrated in THE ELECTRICAL ENGINEER has been reproduced in Chicago on the Auditorium Building during the celebration of the World's Fair dedication. The Emerson Electric Manufacturing Co. furnished the designs and structure for this piece as well as the automatic cylinder operated by a one-eighth h. p. Meston motor, which produces the waving effect of the flags so much admired in St. Louis.

THE SPENCER SPARK ARRESTER.

THE new electrical firm of Taylor, Goodhue & Ames, 827 Monadnock Block, Chicago, are placing a new spark arrester on the market, which possesses a great deal of merit. The previous forms of spark arresters have often been awkward to adjust and clumsy in appearance. The new arrester is well illustrated in the accompanying cuts. Fig. 1 shows the appearance of the spark arrester when properly adjusted to the lamp. Fig. 2 illustrates the manner of adjusting. The clamp on the side firmly holds the arrester in position by securely clamping it on the supporting rod, and as this clamp is adjustable it may be used on lamps with either the supporting rod placed inside the globe or outside. The appearance of the arrester is exceedingly neat and with its novel features it should find a very ready market.

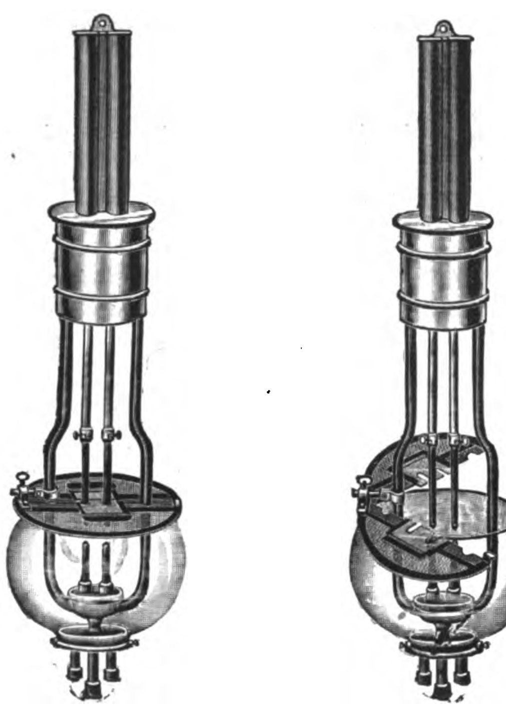


FIG. 1 AND 2.—SPENCER SPARK ARRESTER.

Taylor, Goodhue & Ames call it the Spencer spark arrester, and will be pleased to answer all inquiries and give price upon application.

THE DREXEL INSTITUTE PLANT IN PHILADELPHIA.

WE have made mention before of the immense installation at the Drexel Institute in Philadelphia which was completed about one year ago by Messrs. M. R. Muckle, Jr., & Co. The plant as then installed consisted of three 10 and 18 x 10 inch Westinghouse compound engines driving three large "Special" slow-speed Edison generators which supplied light to about 1,800 lamps throughout the entire building. The plant was of a very mixed description, using Thomson-Houston and Eddy motors, and Sawyer-Man lamps and sockets. Since the plant has been started it has worked with such uniform satisfaction that the same firm received the order a few weeks ago for the fourth engine of the same size and an additional slow-speed dynamo. This was rendered necessary by the large number of motors being installed in the building, and especially by the increasing use of the electric elevator. The throwing off and on of the load suddenly with this elevator when carrying heavy weights would often run the amount of current being used up to such an extent as to endanger the blowing of the fuses when only one or two of the main dynamos were working. As now arranged, all the motors will be run upon the fourth machine so as to prevent overloading at any time, the motor circuits being kept separate from the lighting circuits. The benefit of the Westinghouse compound principle shows in a very marked manner in this plant, since the engine doing this work will run on an extremely varying load. The new dynamo is of course so arranged that if desired it can be thrown in with the other three to help them out on the lighting. It has been determined not to use this electrical plant for the purposes of instruction, but to install a separate dynamo and engine for that purpose. It was not considered wise to risk experimenting with the electric light plant since there is no other means of illumination in the building, and the consequences of any trouble with the lights in an educational building of this size and character might be serious.

MESSRS. NALDER BROS & CO.

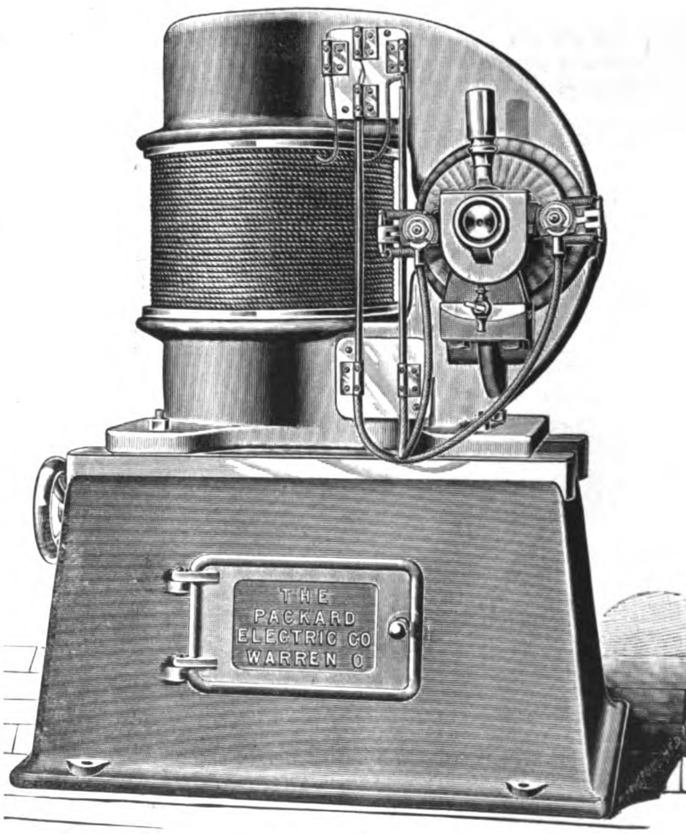
THE fourth edition of the catalogue of Messrs. Nalder Bros. & Co., London, makers of electrical and scientific instruments, contains an eight-page supplement descriptive of new battteries, galvanometers, voltmeters and miscellaneous instruments that have been added to the stock of the firm since the catalogue was issued. Prominent among these is a Kelvin centi-ampere balance for measuring currents from .01 to one ampere.

Both catalogue and supplement are exceedingly well printed and profusely illustrated in blue on heavy paper, and will be found most attractive as well as useful.

THE PACKARD MOTORS AND DYNAMOS.

THE accompanying illustration represents a new design of dynamo or motor built by the Packard Electric Co., of Warren, Ohio, whose New York representative is Mr. Charles E. Chapin, 136 Liberty street. These machines were introduced in view of the increasing demand for small power units at a distance from the centre of distribution, and are claimed to possess very high efficiency. The field is built up of wrought iron bars held in place and shaped by a coating of soft cast iron. The wrought and cast iron unite and form one solid mass, securing a strong magnetic field by the expenditure of a very few watts. There is but one field coil wound upon a movable spool, and but one joint in the magnetic circuit of the machine. The construction is such that the removal and replacement of the field coil is extremely simple. This is a very important item, as every part is built to a gauge, and the voltage of the machine may be thus changed to 110, 220 or 500 volts in a very few minutes. These machines are mounted on a hollow cast iron base which is fitted with a door and designed to be used as a closet for the reception of tools, etc., and are also provided with a belt tightener. They are insulated from this base by hardwood.

The armature is of the drum type and is built up of thin discs securely fastened to a shaft made of the best grade of machinery steel of greatest diameter in its central part. The winding is a modification of the Siemens type, and the armature is so proportioned that there is very little idle wire over the ends. The commutator is constructed of a large number of sections of pure, hard copper insulated throughout with mica, and has ample width of face to secure the best results, and reduce the wear to a minimum. A strong point claimed for these machines is freedom from sparking at the commutator. The brushes having been once set at the non-sparking point, require no changing under extreme changes in load.

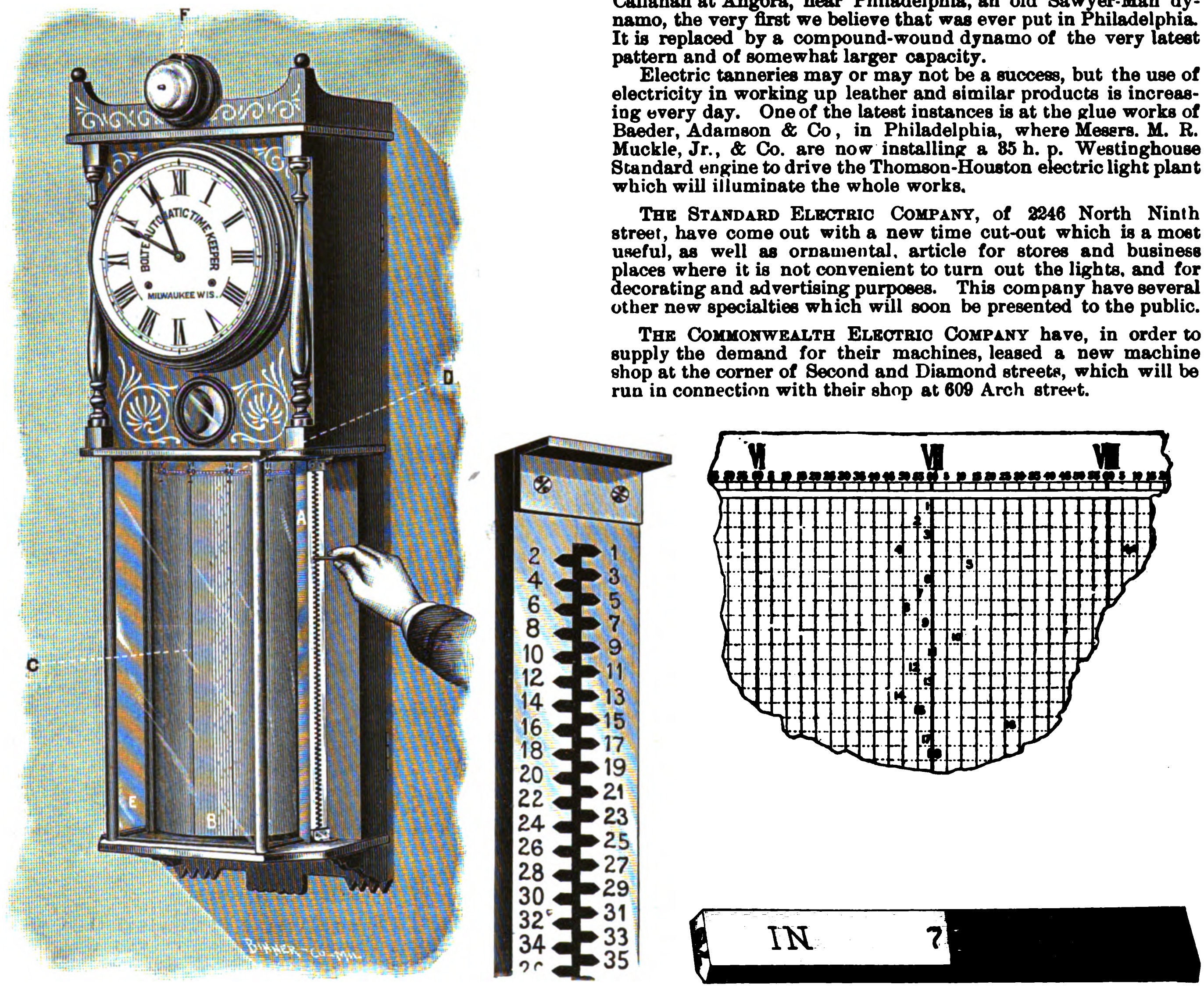


PACKARD MOTOR.

BOLTE AUTOMATIC TIME KEEPER.

The Bolte Automatic Time Keeper is a new device for keeping accurately a record of the time of arrival and departure of employees. Our engraving, Fig. 1, shows the complete detail with clock dial and hand marking the registration.

Fig. 2 shows a section of the upper part of the record sheet. The cylinder around which this record sheet moves turns in time with the hour hand, making one revolution every 12 hours. The heavy line marked 7 o'clock indicates the hour at which the workmen are expected to arrive. The numbers recorded on the left of this line are early, whereas those on the right are late. Each of the light-colored lines indicates five minutes; therefore any one registering three lines to the right of the 7 o'clock line would be 15 minutes late, and as the proprietor enters his establishment in the morning one glance at the clock will indicate those employees who are absent or late, and how many minutes they are behind time.



Figs. 1, 2, 3 and 4.—Bolte Automatic Time Keeper.

Fig. 3 shows a section of the key rack through the openings of which the registrations are made, and Fig. 4 shows the registering key full size. Each workman draws his pay according to a certain number, and in this case the the one shown is No. 75. This number appears in raised letters on each end of the key; the end marked "in" being nickel, the end marked "out" being of copper. The indication of an employee registering "out" is shown by a star (*) being placed after the number, thus; 75*.

The value of this device is apparent. Each workman makes his own registration and cannot complain of the time keeper and on the other hand, no collusion is possible between time keeper and employees. By actual use it has demonstrated the fact that employees are much less liable to be late, as by the use of the Bolte automatic time keeper not only the workmen themselves are able to inspect the record, but their employers are able each day at a glance to ascertain the numbers and names of those who are arriving on time, or others who are habitually late or absent. The device will be placed on the market by the National Time Recorder Company, 361 and 363 East Water street, Milwaukee, Wis.

PHILADELPHIA NOTES.

It was indeed a recalling of old times when Messrs. M. R. Muckle, Jr., & Co. took out from the mills of the estate of George Callahan at Angora, near Philadelphia, an old Sawyer-Man dynamo, the very first we believe that was ever put in Philadelphia. It is replaced by a compound-wound dynamo of the very latest pattern and of somewhat larger capacity.

Electric tanneries may or may not be a success, but the use of electricity in working up leather and similar products is increasing every day. One of the latest instances is at the glue works of Baeder, Adamson & Co, in Philadelphia, where Messrs. M. R. Muckle, Jr., & Co. are now installing a 35 h. p. Westinghouse Standard engine to drive the Thomson-Houston electric light plant which will illuminate the whole works.

The Standard Electric Company, of 2246 North Ninth street, have come out with a new time cut-out which is a most useful, as well as ornamental, article for stores and business places where it is not convenient to turn out the lights, and for decorating and advertising purposes. This company have several other new specialties which will soon be presented to the public.

The Commonwealth Electric Company have, in order to supply the demand for their machines, leased a new machine shop at the corner of Second and Diamond streets, which will be run in connection with their shop at 609 Arch street.

Separate Engines for Lighting Mills.—The advantage of a separate engine for driving the electric light plant of a mill is becoming more and more apparent every day, and as a consequence many of those who in their early installations drove the dynamo from the main shafting are now making the necessary changes. Among others the Thomas Kent Manufacturing Company have just purchased a 35 h. p. Westinghouse standard engine from M. R. Muckle, Jr., & Co. to drive their dynamo which has been in use for several years.

Messrs. Walter C. McIntire & Co., of 506 Commerce street, are overrun with orders for their Crown shade or reflector for incandescent lamps. During October they have shipped 2,000 to Drake, Payson & Whittier, Providence, R. I.; 1,800 to the Edison Electric Light Company, Fall River, Mass.; 1,400 to the Scranton Electric Light Company, Scranton, Pa.; 600 to Manion & Co., New Orleans, La., besides filling many smaller orders throughout the country.

The La Roche Electric Works report that they never before were so pressed with orders for large plants as at the present time. They are running their factory night and day and will have to do so for some time to come.

THE CARPENTER ENAMEL RHEOSTATS.

The latest development in the line of enamel insulation is the issuance of a patent, under date of Aug. 30, 1892, No. 481,781, broadly claiming the fundamental features of enamel rheostats. The patent is issued to Chas. E. Carpenter, and is assigned to the Carpenter Enamel Rheostat Co., of Bridgeport, Conn. The patent was applied for upon February 18, 1891. The Carpenter Enamel Rheostat Company states that the recent decision of the Commissioner of Patents awarding priority to Morford for a similar invention for electric heaters has no bearing on rheostats, as the specification and the claim in Morford's patent is limited to "electro heating apparatus."

The issuance of the present rheostat patent so soon after the Commissioner's decision is claimed to remove all doubt as to the independence of the inventions.

THE RIES REGULATING SOCKET IN PITTSBURGH.

The following is a testimonial received by the Ries Electric Specialty Co.:

Pittsburgh, July 13, 1892.

W. S. Teeple, Esq., Special Agent, Ries Electric Specialty Co.

Dear Sir.—This is to certify that I have examined the Ries regulating socket and find in it all that the company have claimed for it as a convenient and thorough regulator of electric incandescent lighting.

The application of the principles involved, as well as the utility of the invention, are unique, the device being positive in its action, saving in its results, at the same time simplicity itself.

Very respectfully yours,
Morris W. Mead,
Sup't Bureau of Electricity.

A PROPOSED PLANT FOR CHESTER, ILL.

We have received from Mr. J. D. Gerlach, cashier of the First National Bank of Chester, Ill., a prospectus of a proposed electric light, water and ice plant for that and the adjacent towns. A 35 arc and a 1,000 light incandescent dynamo will probably be required, and the alternating system will be used. The electric plant will cost, it is estimated, $16,883. The city is ready to contract for 23 arc lights. The total cost of the three plants combined is estimated at $84,148, and Mr. Gerlach is anxious to form a company to carry out the enterprise.

PECULIAR VALUE OF GRAPHITE FOR ELECTRICAL WORK.

If a stick of graphite is made six inches long and one-quarter inch in diameter, it can be so made that it will possess an electrical resistance of one ohm or 1,000 ohms. Furthermore, if such a stick of 1,000 ohms is cut in three-inch lengths, each length will be found to possess a resistance of 500 ohms. This homogeneousness of the mass enables the electrician to easily solve some difficult problems that would otherwise call for expensive appliances.

For telephone switchboards and other uses where the current is not great and where the resistance is variable on account of induction from near-by trolley wires or other causes, graphite resistance rods have been found very valuable.

Graphite resistance has also been successfully introduced in sockets intended for regulating the light of incandescent lamps, and as the graphite can be formed in many different shapes as well as in varying resistances, the field is a very promising one. The Joseph Dixon Crucible Co., of Jersey City, N. J., have already filled many orders for such material.

WESTERN NOTES.

The Electrical Supply Company have placed upon the market a new Wirt ampere indicator and Wirt volt indicator for stationary work, which are furnished for either direct or alternating currents. These instruments are intended to be left in circuit continuously and are guaranteed unconditionally as to accuracy. This company has also introduced the Wirt lamp-regulating switch for single lights, the principle of which is said to be totally different from other devices of its class.

Taylor, Goodhue & Ames, 827 Monadnock Building, have been appointed general selling and distributing agents for the direct current motors manufactured by the Wagner Electric Manufacturing Co., of St. Louis, and also the direct and alternating current fan motors. These machines possess new features of special merit, and in construction and workmanship rank second to none.

Car Heaters.—The Electrical Supply Co., corner Randolph street and Michigan avenue, Chicago, has secured the general agency for the well-known Carpenter electric heaters. They have already closed some large contracts with electric railways for their entire equipment. The Carpenter heaters have many points of excellence commending them to progressive railway managers.

Peoria, Ill.—The city council has granted the Edison Co. and the Central Co. electric lights ordinances. They put the rate for lamps so low that the companies have not accepted them and probably will not. It is a big reduction in rates that the present company are charging. The Rapid Transit Co. are now running their cars regularly and are doing a good business.

Taylor, Goodhue & Ames, 827 Monadnock Building, report that although so recently organized, the amount of business already received, and the kind reception accorded the new firm, both by their friends and competitors, have been exceedingly gratifying.

NEW YORK NOTES.

The Standard Paint Company continues to enjoy an active demand for its paints and compounds in the electrical field. The Buffalo Street Railway Company have recently placed with the Standard Underground Company, of this city, an order for 50 miles of heavy underground feeders, the outside to be protected by braid thoroughly impregnated with P. & B. insulating compound. This is one of the largest single orders of the kind ever placed by an electric street railway company.

W. S. Chesley & Co., electrical engineers and contractors, Electrical Exchange Building, have severed their connection with the Easton Electric Co., of Brooklyn, and desire the agencies of electric light apparatus and appliances. This company have just completed a new machine shop at No. 24 Morris street, Jersey City, near Cortlandt street ferry, where they have facilities for repairing all kinds of electric light and power apparatus.

The Electric Engineering and Supply Co., of Syracuse, N. Y., have issued notice withdrawing quotations on all goods of their manufacture. New quotations will be furnished on application.

NEW ENGLAND NOTES.

The Beacon Vacuum Pump and Electrical Co., of Boston, have issued a very pretty souvenir entitled "An Illustrated History of Illumination, from Prehistoric Times to the Beacon Incandescent Lamp." The folder is from the Coke Printing Co., of Boston, and contains six views of lights—a fire of sticks, an olive oil lamp of the first century, the tallow dip of later days, a modern oil lamp, a chandelier, and, finally, a Beacon lamp, which is designated as "the lamp of the future."

The Carpenter Enamel Rheostat Co., of Bridgeport, Conn., have quite recently finished doubling their furnace capacity. They are running their works night and day with this enlarged capacity. These rheostats seem to meet with universal approval from electrical manufacturers and engineers. The theatre and street car rheostats seem to be especially appreciated. The fact that these rheostats are cheaper than those formerly used no doubt partially explains the demand for them.

The Jackson & Woodin Manufacturing Co., of Berwick, Penn., have placed the contract for the new car wheel foundry with the Berlin Iron Bridge Co., of East Berlin, Conn. The building will be made entirely of iron, from the designs of the Berlin Company.

SOUTHERN NOTES.

The Brush Electric Company, of Cleveland, Ohio, through their agents, S. W. Trawick, of Atlanta, Ga., and A. D. Dorman, of New York, have just closed a contract with the Mutual Light and Power Company, of Montgomery, Ala., for a complete central station plant, the consideration being considerably in excess of $100,000. The plant will comprise 300 arc lights capacity, 2,500 16 c. p. incandescent lights capacity, 700 h. p. generating capacity, 700 h. p. Hamilton-Corliss engines, 700 h. p. Heine safety water-tube boilers, all necessary shafting, friction clutch pulleys, couplings, etc., and all construction work for arc, incandescent and power circuits. The contract for the complete steam power plant was awarded to the Heine Safety Boiler Company, of St. Louis, represented by S. C. Munoz. The Heine Company have sublet the engine portion of the contract to the Hamilton-Corliss Engine Company, represented by J. A. Vail, of St. Louis. The complete plant must be installed and in operation by Jan. 1, 1893.

Mr. J. M. Zamoiski, of the Ries Electric Specialty Company, has returned from Hanover, where he closed a contract with the Hanover Silk Works Co. for a complete electric lighting plant of 150 16 c. p. lamp capacity.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.
VOL. XIV. NOVEMBER 2, 1892. No. 235.

The Sprague-Pratt Electric Elevator for High Duty Service.

By

Frank J. Sprague And Chas. R. Pratt.

I.

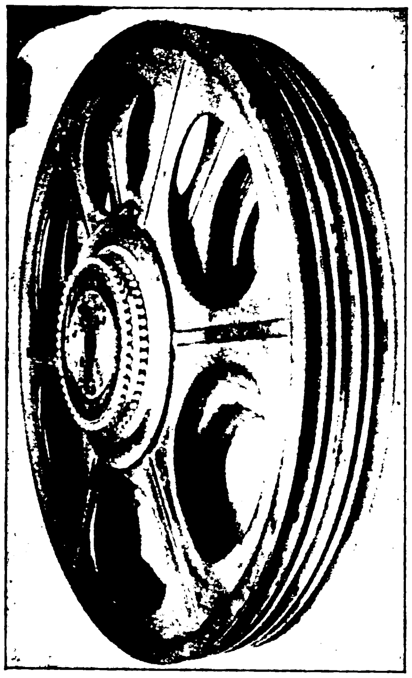


FIG. 1.

ONE of the most important applications of the transmission of power, and one destined to rival in extent the railroad work which has made such great strides in the past five years, is that of the operation of all classes of elevators and hoisting machines.

Some idea of the extent of the present business may be gathered from the fact that in New York alone there are not less than 4,000 elevators of various kinds, more, in fact, than there are street cars.

Assuming for the moment that there will be general or special systems of supply, the business of electric elevators, when fully developed, may be classified as follows:

1st. High speed passenger service where no hydraulic plant is possible.

2d. High speed passenger service in competition with hydraulic plants, the electric plant doing equal duty, costing less, occupying but a small fraction of the space required by the hydraulic, and costing much less to run.

3d. Substitution of new high speed electric service in place of old steam and slow hydraulic service in buildings where the limited space and interference with operations will not permit of any consideration of a new hydraulic plant.

4th. Passenger elevator service in buildings where the loads are comparatively light.

5th. Passenger service in private houses where safety, simplicity and noiselessness are essential.

6th. Freight and special classes of work.

Of the above classes of service the first three may be designated as "first class," and they require speeds of from 300 feet up per minute. The others may be termed "second class," and require speeds of from 50 to 225 feet.

In considering the possibility of electric elevator growth it is hardly necessary to assume sources of supply. The fact is that, independent of isolated plants from which source of power the current can be taken to operate electric elevators, and in addition those which will be put in for the special operation of elevators, there are in the United States alone not less than 350 stations supplying currents of constant potential of from 225 to 250 volts, and engaged in the business of supplying current for electric light and power, and no less than 400 stations supplying similar currents of from 450 to 500 volts for the operation of railway and stationary motors, making a total of not less than 750 electric stations now available.

In addition to these a large number of other general stations will be in operation in the near future, so that the field for work is practically unlimited, and in most places where it is advisable to operate an elevator from a central station there exists, or will soon exist, a station capable of supplying the necessary current.

This growth of electric central station plants is fast making possible elevator service in buildings heretofore denied it, and on account of the greatly increased return from tenants, the rapid introduction of electric elevators is assured.

This latter fact is entirely independent of that business which has already been outlined and which is determined by other considerations.

Having thus generally shown the possibilities of the electric elevator business, we shall, after giving the general conditions of elevator service, and making some special comments upon the hydraulic system, describe in detail, in connection with the specific conditions of elevator service, a new machine, the Sprague-Pratt express electric elevator, which has been designed to meet the first-class service, and which has entered the lists against the hydraulic elevator, and has challenged it on equal conditions of high duty.

To be successful, it must duplicate hydraulic service in movement and safety, and it must do it with collateral advantages. No plan hitherto advanced has been able to cope with the difficult conditions now demanded in fast office work, but it is believed that this elevator has the following characteristics:

It equals the speed and smoothness of the hydraulic.

It will start and stop more softly.

It occupies from one-quarter to one-tenth the space of the hydraulic operating plant.

It costs less than one-half to operate.

It is safer than the hydraulic.

II.

As already stated, there are two general classes of elevator service, and there have been two kinds of machines developed to perform these services when passengers are carried.

The first class has been developed by the increased height of buildings, which has demanded a service of high speed and smooth motion, regardless of cost of apparatus, space occupied, or cost of operation. The hydraulic elevator is the result of this demand, and is the only one that has, up to the present, been accepted for his service. It is to meet this demand—by introducing an elevator which will do the work equally as well as, if not better than, the hydraulic, and which would have the qualities already stated, that the elevator to be described was designed.

The second class of elevator work is that service which requires lower speeds. This applies to small apartment and private houses and other buildings of four or five stories high where light elevator duty is required. This service is excellently supplied by worm gear elevators, which are now becoming popular in electric form, and for which the business will be very large.

The substitution of an electric motor for a steam engine cannot much improve the motion or increase the speed and capacity of the present worm gear machine. This form of elevator was discarded for general high speed service over ten years ago, that is, as soon as the hydraulic set the pace at 300 feet per minute and over.

Nothing can prove the limitations of a worm gear elevator more clearly than the simple fact that, costing less than two-thirds as much to build as the hydraulic, half as much to run, and occupying about one-third the floor space, it never has been used for first-class high-speed service. Several of the leading elevator companies of this country which have built these elevators for over thirty years have spent unlimited skill and money trying to make a worm gear elevator do the work of a hydraulic and be accepted for such work, and thereby command a higher price for that which cost them less to build.

There are few people who buy elevators either for themselves or as agents for others, who care to know upon what mechanical principle an elevator is built. All they wish to know is the speed, load, space occupied, first cost, and cost of operation; the rest they trust to the reputation of the elevator builders. This is not so unreasonable when it is considered that they are limited in their selection: for speeds over 300 feet per minute, a hydraulic from the lowest bidder of the four or five leading companies; for less then that speed, a worm or spur gear in the same way. The comparative merits of such elevators are too nearly equal to be worth special consideration.

What are some of the disadvantages of the hydraulic system? The architect, the builder and the operator are familiar with them. There are of course the necessary boilers and pumps, the latter as used for general elevator service being the most uneconomical of power producers.

The water must be stored in a roof tank of large capacity to which it is delivered through long lines of standpipe which telephones the throb of the pump throughout the building, and which must have special provisions of support; or it must be stored in a compression tank in order to prevent the pulsations of the pump being transmitted to the car, and to give a sufficient amount of water under pressure to start the elevator promptly. This tank requires constant watching by the engineer to prevent the water line from getting low enough to allow the compressed air to get into the elevator cylinder and thereby cause the elevator car to jump up and down in a most uncertain manner; this is not an unusual occurrence.

There must be provided return pipes and an overflow or discharge tank. On account of the position of the pumps and the duty required, the water is almost invariably pumped against a pressure greatly exceeding the hydrostatic head corresponding to the travel of the cars, the pressure in some instances being very nearly double this.

The cylinders are placed either in the basement where they belong, but where they take up valuable space, or vertically in the shaft, thus limiting the size of the cars and cutting up valuable space. Frequent packing of the cylinders is required, leakage is almost always taking place, and both troubles are intensified with the longer runs, greater speeds, and higher pressures demanded in modern buildings.

Erratic jumping or racing of the car because of air in the cylinders, or stretch of the controlling rope, or imperfection of the valve, or lack of skill of the operator are not unfrequent, and creeping of car because of leaky valves is a fruitful cause of annoyance.

Add to this the lack of economy of the hydraulic, and one has the situation in a nutshell.

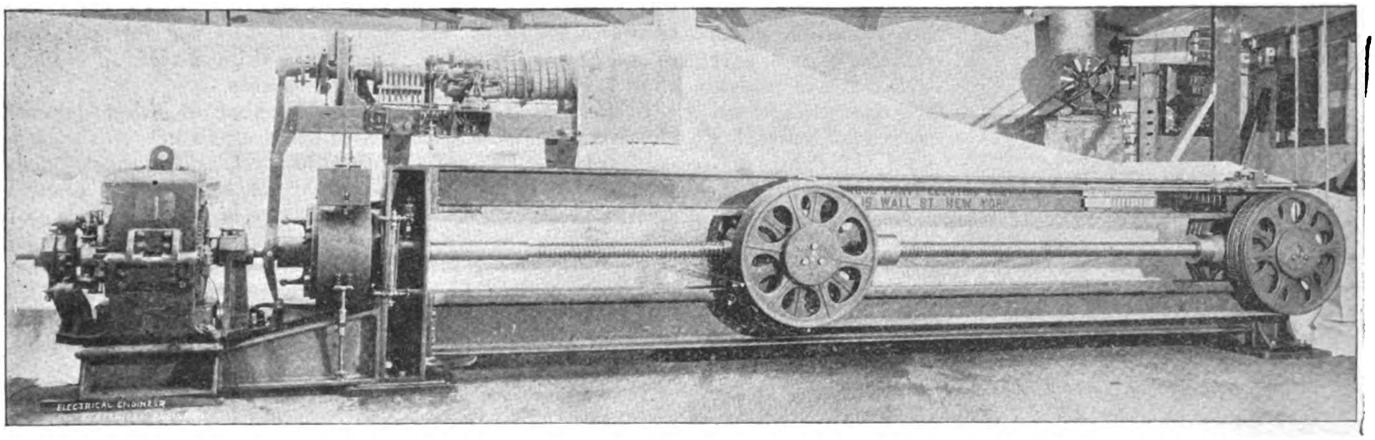


Fig. 2.—General View of Sprague-Pratt Electric Elevator.

III.

Such then being the general conditions of elevator service, let us see how they are met in the machine under consideration, and in order to do that, a brief description of the machine itself as illustrated in a general view in Fig. 2, and in detail in the remaining figures, is in order.

By a reference to the illustration it will be seen that the general character is that of a horizontal multiplying sheave hydraulic machine with a traveling cross-head. There is a main frame having an upper and lower guide and end pieces dovetailed into and bolted to them. Through the middle extends a screw of peculiar construction centered at the outer end and supported by a bearing at the inner end, where is also placed a thrust bearing external to the frame. The screw passes through a compound safety and working nut connected by a friction seat with a forged steel cross-head having trunnions on either side each of which carries a nest of sheaves mounted on ball bearings. Sheaves of the same size and corresponding in number are carried on a spindle anchored at the outer end and from these the hoisting ropes lead to the overhead sheaves. At the inner end of the screw is a brake wheel held normally by a steel and leather brake band anchored on the motor frame
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and operated through a double toggle joint by the movement of a weighted lever controlled by a shaft and link chains driven by the pilot motor. In line with the extension of the screw is the shaft of the armature of the hoisting motor, which is coupled to the end of the screw by a sliding coupling and which carries also the centrifugal governor. In hoisting, the armature turns the screw, which, operating on the ball nut, moves the cross-head so as to increase the distance between the two sets of multiplying sheaves, and in lowering, the weight of the car on the hoisting ropes draws the sheaves together, and through the ball nut revolves the screw and turns the motor. The motor takes current from the line in hoisting, but in lowering it is cut off from the line and is operated as a driven dynamo by the falling weight of the car. The controlling apparatus is carried above the brake strap on the inboard end of the frame, and consists of a pilot motor controlled from the car, a secondary controlling switch through which the car switch operates, a rheostat connected to a peculiar spiral switch, and a making and breaking switch and brake chains likewise operated by the pilot motor.

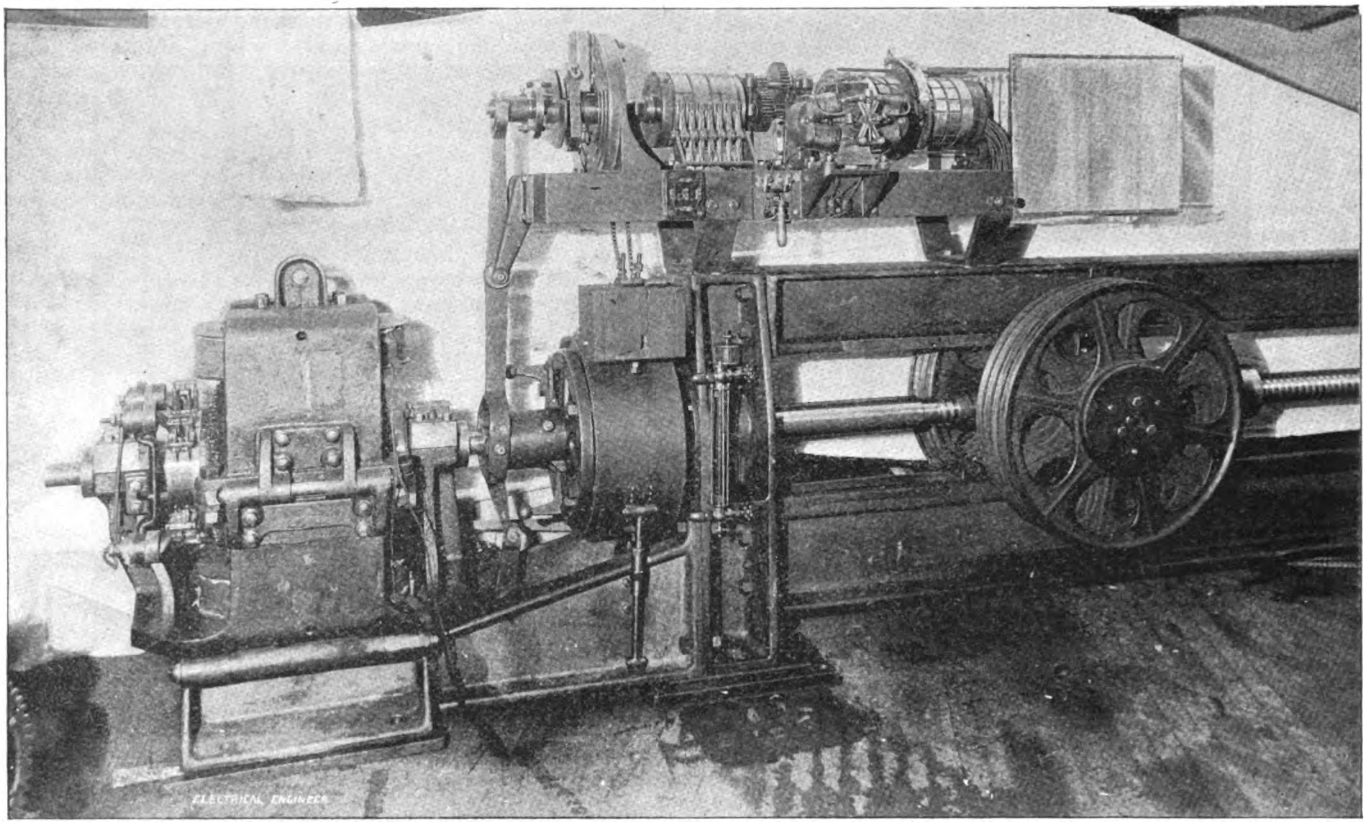

Fig. 3.—Front View of Motor End of Elevator.

The thrust of the screw being taken up on the inboard end, the strain on the screw is invariably between that end and the traveling cross-head, and never beyond this; hence, it is always under extension, never under compression.

The function of the brake is that of locking the screw when at rest, and not a means of varying the speed. In case of accident it has the additional function of helping to stop the screw.

The operation of the various parts will be more apparent in the detailed description of the elevator's functions. The remaining figures are as follows:

Fig. 3 shows the front view of the motor end of the elevator, with the cross-head near the upper limit, with the regulating apparatus in normal position, the brake lowered and the screw at rest. It shows, also, in detail, a part of the safety apparatus, mainly the operating lever, which, being moved at one end by either the centrifugal brake, or through a rock shaft by the upper travel of the cross-head or by a gravity drop in case the current fails, releases certain cams in the regulating switch, breaking the hoisting circuit, if need be, closing the circuit of the armature locally, and dropping the brake-band upon the brake pulley.

Fig. 4 shows a back view of the same end of the machine, with everything in its normal condition. The additional feature which is illustrated is the upper limit safety, the gravity drop, locked when the line circuit is closed, and the magnetic release in case the line is open.

Fig. 5 shows an end view of the motor end of the machine with the motor disconnected and pivoted out of position, leaving the brake apparatus and thrust-bearing free of access.

Fig. 6 shows the trunnion cross-head with one set of sheaves removed but with the operating ball-nut and the safety nut in place.

Fig. 7 shows the same cross-head with the parts of the nut disassembled.

Fig. 8 shows the machine generally disassembled; the brake, thrust bearing and automatic devices removed, the nuts and ropes off, the motor pivoted out of position, and the screw partially withdrawn. This complete disassembling of the machine can be done within an hour, and it can be restored in a similar time.

Fig. 1 shows one set of sheaves with the outer sheave removed and the ball-bearing exposed.

Fig 9 is the operative switch of the car; its functioning will be described later.

Fig. 10 in an architect's diagram.

IV.

In considering whether an electric elevator merits the attention which may be claimed for it, attention should be given to the specific conditions of passenger elevator service. These are to be considered in the function of hoisting, lowering, and the operation of the safeties.

The function of hoisting involves:

1st. *A smooth running and reliable motor under absolute* *control.*

However the motion of the prime motor is transmitted to the car, it is, of course, essential that the movement of that motor shall be perfectly smooth and even, and that changes in its speed shall be progressive and without shock. Since, also, the movement of the car is coincident with that of the motor the control must necessarily be absolute in order for the car movement to be safe.

The question of control of the motor for elevator work has been much discussed, and it can only be satisfactorily determined in connection with the duty demanded of an elevator, and will be settled by first cost, effectiveness, and eventual economy.

In this connection a few facts are interesting. In fast office work the elevator hoists from one-fifth to one-sixth of the time on duty. In hotel and less severe office duty the hoisting time varies from one-ninth, as in the Auditorium, Chicago, one-tenth, as in the Gerlach, and one-twelfth in the Grand, New York, to one-fifteenth and even one-twentieth in other work.

Considerations of economy as well as first cost and effectiveness have then led to the adoption in this elevator of a motor having a light shunt field, variable at will, a strong series coil, and a rheostat for governing the inlet of current in hoisting, and for governing the dynamic action in descending.

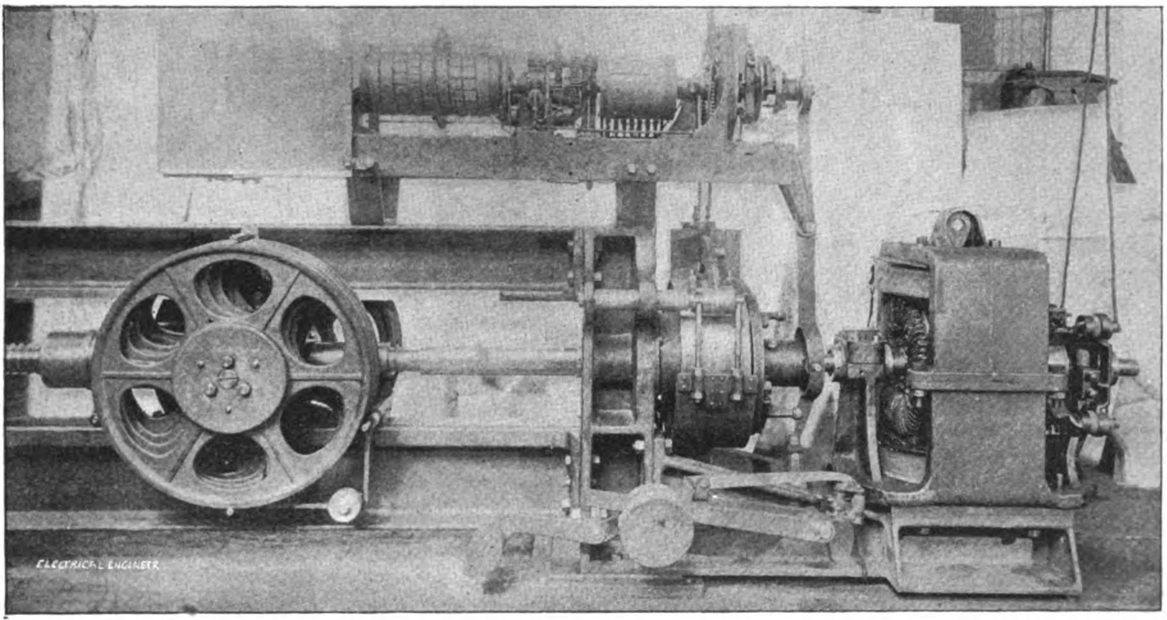

FIG. 4.—BACK VIEW OF MOTOR END.

A year's experience has demonstrated beyond question this to be the most economical method.

2d. *A gradually accelerated start independent of the skill or humor of the elevator boy.*

There are few people who on entering a fast elevator car do not watch the operator and involuntarily brace themselves to resist the sensation of being tossed into the air or of having the floor fall from under their feet. It is not necessary to attain a high speed to produce this sensation, nor is it necessary to produce this sensation in attaining a high speed. The car cannot start too promptly in response to the car switch, but once started, its maximum acceleration should be in a fixed time, as fast and no faster than is consistent with bodily comfort.

If all elevators had the same rate of acceleration of speed that this electric elevator has, people would think no more of stepping into an elevator car than of going from one room to another.

Having determined upon an electric motor as the driving part of an elevator system, it was but logical to make use of a pilot motor to replace the ordinary hand rope. By the operation of this pilot motor results are obtained as follows:

In hoisting, the switch lever in the car is thrown to the "up" position, closing the circuit through the controlling motor, which after having first closed the circuit through the armature of the hoisting motor, the fields of which are separately excited, and having cut out sufficient resistance to prevent the car load from driving the armature backward, raises a brake from contact with the screw and armature shafts, and continues to cut out resistance until there is sufficient current to start the hoisting motor, and if the controlling motor be allowed to finish its run, it will cut out all the resistance and put the hoisting motor to its full speed.

This operation could, if desired, put the car to full speed in less time than most hydraulic elevators can be with a shipper rope. Or it could be adjusted to take any length of time desired, but however it is adjusted, it determines absolutely the minimum time of attaining full speed by movement of the car switch, or its maximum acceleration of speed. It is obvious that with this arrangement properly adjusted no careless or vicious elevator boy can cause discomfort to the passengers.

To stop the car in its ascent the car switch lever is returned to the central or "stop" position, which movement closes the circuit in a reverse direction through the controlling motor, which cuts in the resistance to the hoisting motor armature's circuit, applies the brake, and opens the circuit.

3d. *A start that will not seriously affect the lights on the same circuit.*

This condition can, of course, only exist on a circuit capable of maintaining its potential under the full working load of the hoisting motor, which condition exists in the best public lighting circuits, and where this is not the case the demand for this power current will create the supply.

Such a circuit being given, it only remains to adjust the elevator switch to suit the capacity of the circuit, which adjustment is capable of wide variation. There are few good circuits which through the action of this switch will not permit of as rapid start as is desired on the score of physical comfort. Here again the fixed time element of starting is necessary to prevent disturbance to the lights through the carelessness of the elevator boy.

4th. *Control by the car switch that will enable the operator to make the most limited movement required.*

This operation is effected by the instantaneous response of the motor to the switch movement, the fine gradation of the current, and the freedom from friction of the whole system.

5th. *Any desired variation of speed by the car switch for any distance of travel.*

To accomplish this result three conditions are necessary :

a. Resistance that will not overheat.

b. A switch with a sufficient number of contact points to keep down the difference of potential between points to a non-sparking and a non-heating condition.

c. A high-breaking speed of contacts to prevent arcing.

d. A switch with sufficiently large contact points to insure full carrying capacity on each clip or point.

In short, to make a rheostat that will carry the hoisting motor's current with the switch brush in any position, taking in any portion of the resistance, for any length of time, without dangerous heating of the resistance and without injury to the brush or contacts.

This condition is sometimes necessary where two or more elevators are running together, as may be the case where one elevator has to stop at several stories going down and the other has a straight run to make to an upper story ; in order for the latter not to catch up with the former and break up the alternating time table, it must in some cases run very slow, whichever way running.

The construction of the rheostat makes it practically fireproof, and the total resistance is such as will prevent burning the contacts at the last break in stopping.

This resistance is divided into a large number of divisions so as to reduce the potential between successive contacts. The resistance sections are connected to bronze contact plates of large area and ample carrying capacity. As the arrangement of contact points has to be extended to the lowering end of the switch, they would, if developed into a straight line, occupy over 10 feet lineal space, or a circle over three feet in diameter.

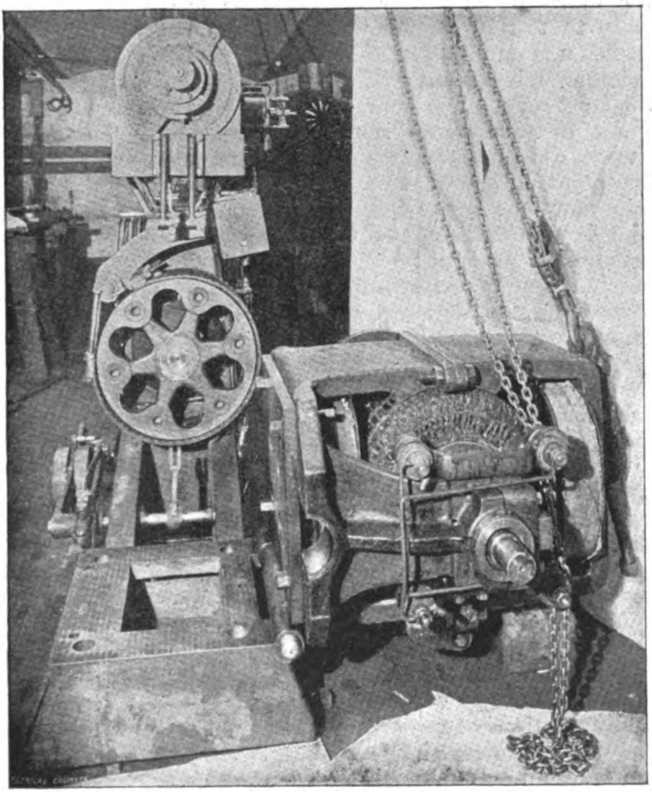
FIG. 5.—MOTOR DISCONNECTED.

To put this into compact form, a spiral arrangement of contacts is used, over which a carbon brush travels at a high speed. The contact plates are screwed to the outside of a hollow cylinder, and wires from the rheostat lead to the inside of this cylinder and through its walls to the contact plates.

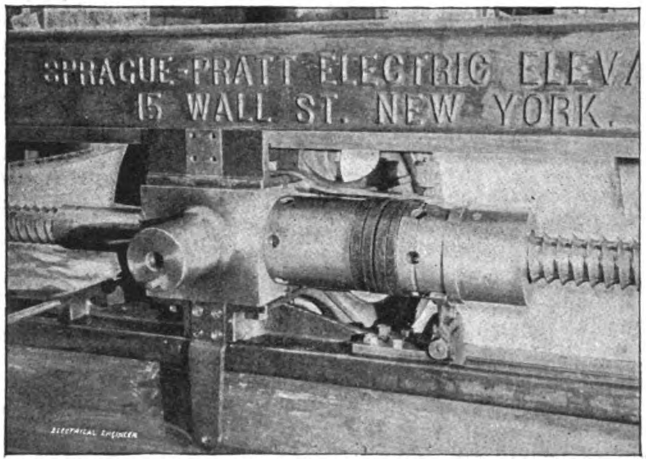

FIG. 6.—NUT SYSTEM, SPRAGUE-PRATT ELEVATOR.

The controlling motor which regulates both the hoisting motor circuit and the brake is under perfect control of the car switch, and also cuts out its own circuit and stops itself at the extreme up and down positions, and returns the main switch to stop with the brake applied when the car switch is put to the stop position in the car.

Its connection to the car switch is made by four copper wires laid in a flexible cable looped to the elevator car from a point half way up the hoistway.

6th. *Unlimited speed at an absolutely smooth motion.*

This, in the Sprague-Pratt elevator, is a condition inherent in the general principle of the machine.

This is obvious when it is considered that the transmission of power developed by the revolving armature of the electric motor is communicated direct by means of a nut and screw to precisely such multiplying sheaves as are usually driven by the piston of a hydraulic elevator cylinder. Substitute a frictionless nut and screw for the hydraulic cylinder, attach the nut to the cross-head of the travelling sheaves, revolve the screw with an electric motor, and one has the fundamental principle of this elevator.

Experience having shown that the multiplying sheaves of the hydraulic elevator were the best means of communicating a perfectly smooth high-speed motion to the car, the problem resolved itself into the question of what was the best means to operate these sheaves without the expensive complications of a hydraulic plant.

The only way to do this with no vibration and perfect safety is by a nut and screw, and to obtain a perfectly even acceleration to the speed at which this screw must be revolved and a perfect control of same the electric motor is peculiarly adapted. Taking for example an elevator of 8 multiplying sheaves, the traveling sheave carriage will move one-eighth as fast as the car; assume the pitch of screw to be one inch; then for every revolution of the motor, the car will rise eight inches, and 450 revolutions per minute of the motor will give a speed of 300 feet per minute to the car. Suppose the elevator to have 12 multiplying sheaves, and the pitch of screw to be two inches and with double thread; then for every revolution of the motor the car will rise two feet, and 450 revolutions per minute will give a car speed of 900 feet per minute. This range of speeds covers any demands for high-speed service, and is safely within the capacity of this type of elevator, which is capable of arrangement for any speed between these limits. An unpleasant sensation sometimes felt in a hydraulic elevator, even when the apparatus is in perfect order, is due to the pulsation of the car caused by air getting into the cylinder, and is occasioned by carelessness on the part of the engineer. Of course this cannot occur in the electric motor and there is nothing between the motor and the car cables to cause a pulsation or vibration except the elasticity of the cables themselves.

7th. *An automatic stop operating at or just above the upper story, that renders it absolutely impossible to drive the car into the overhead timbers and break the ropes, or bring any undue strain on the hoisting apparatus.*

In the first place there is on this hoisting machine a trip operated by the traveling sheave cross-head which applies the brake and cuts out the hoisting current at or just above the upper story. In addition to this there is an absolute and safe automatic stop to the hoisting ropes embodied in the simple action of the hoisting nut and screw, as follows: The screw revolves and the nut travels along the screw, therefore the nut must be held from revolving in order to transmit motion to the car. The nut is so held merely by the friction of the pressure of the load, increased by the multiplying sheaves, and applied to the nut by the cross-head on which the sheaves are mounted. At the end of the screw at which the nut arrives when the car has reached the upper story the thread terminates and a solid collar is there placed, and when the nut meets this collar it locks with the screw, revolves with it without stopping the motor or straining anything, but effectually stopping the car without preventing its being lowered again by the operator in the car.

Any automatic stop to cut off the hoisting power and apply a brake is liable to fail, and such failures have caused accidents. In this machine such an accident is impossible, and there is no other elevator built on this principle.

8th. *Means for preventing the car from descending, or any injury occurring to the switches or motors, in case of an interruption of the current.*

It is a simple matter, and often used, to introduce an electromagnet into the hoisting circuit which releases the brake and holds the car from descending if the current fails. But suppose this is all that is done, and the current was only interrupted for a second or two, as sometimes happens, and the operator has left his switch closed for full speed up; then this may be the result: The motor is at rest, the brake is on, and the full force of the line is closed without resistance through the motor. The result will be either the fuses will blow out or the armature will be injured, and in either case the car will be put out of operation until the damage is repaired by some one outside of the elevator car.

In this elevator an electromagnet in the shunt field circuit not only applies the brake, but also returns the main switch to the neutral point at the same instant, thus preventing injury to the electric apparatus upon resumption of the line current. In hoisting, however, this action does not take place until the car has stopped its ascent, for the following reason: The shunt fields being separately excited have their terminals joined to the same line wires that feed the armature; when the line current fails, or the main fuses blow from an overload, the fields are left in series with the armature, and while the armature continues to revolve by its momentum after the current has ceased, it generates sufficient current through the locking magnet to hold its armature until the hoisting motor stops. This time of this action can be varied at will so that the magnet will drop its armature the instant the line current stops, or retain its armature by over-saturation until the hoisting motor has stopped and reversed a few revolutions. The advantage in delaying this action until the car stops naturally is to prevent the slacking of the hoisting ropes by a sudden stopping of the hoisting machine caused by the failure of the current and application of the brake at the same instant while the car is going up at full speed.

In descending, the action of the magnetic stop is instantaneous but still brings no strain on the car.

9th. *Highest possible efficiency.*

The transmission of power from the motor to the car platform is entirely upon rolling friction, consisting of half-inch hard steel balls rolling upon hard steel surface. It is evident that this system is materially more efficient than a worm-gear elevator, and would consume about one-half the power for equal hoisting rope duty that the average worm gear elevator would consume.

The total efficiency of this elevator, reckoned from the electric energy supplied to the motor to the work performed at the hoisting ropes, is about 50 per cent. as against about 25 per cent. for the hydraulic.

The wasted energy in the hydraulic system is partly due to the fact that for every foot the car is raised, the same amount of water and under the same pressure is supplied whether the car be full or empty. The average load applied to the hoisting ropes of a passenger elevator is not over two-fifths the maximum. Then, again, the pressure is greater than is equaled by the hydrostatic head corresponding to the car travel.

The energy expended is therefore that exerted at the hoisting ropes at the maximum load plus that lost in overcoming mechanical and water friction, and this is further augmented by the low steam efficiency of the pump.

A careful investigation was recently made of one of the most extensive and important modern hydraulic plants, equipped with the best machinery supplied by two of the leading makers, to determine the power required to operate them for a period of 24 hours. This investigation has shown beyond dispute that it takes from 60 to 70 pounds of water for every horse power delivered to the water column, and that the efficiency of the elevator from that point on is only about 25 per cent. This, it is to be remembered, is a plant where there is every reason to expect the most economical hydraulic performance.

An electrical comparison is here in order. The experience of the past year has demonstrated that on this identical plant, if operated by electricity, there would be delivered to the motor terminals only one-half of the energy that is now delivered to the hydraulic column, and when taking into account the difference of economy of operation of a steam pump on hydraulic service and an engine and dynamo operating a general electric service there would be consumed only *one-third of the coal for this elevator system if operated by electricity as there is now consumed as operaated by the hydraulic system.* These statements cannot be gainsaid, and it is no wonder that one of the leading architects of the United States, who has had abundant opportunity to gain a practical knowledge of both systems, pronounces this electric elevator to be, in all probability, a controlling factor in the elevator industry of the country, and that a well-known builder has stated that the performance of this machine marks a revolution in the elevator industry.

V.

The rolling friction is applied as follows:

There are two separate nuts, one of which transforms the revolutions of the screw into a straight line motion of the travelling multiplying sheaves. This is called the hoisting nut. It engages twelve of the screw's threads, or more strictly speaking, twelve convolutions of the screw's thread, and between its thread and the screw thread there are 300 half-inch hard steel balls. These balls place the transmission of power between the nut and screw upon purely rolling friction; no part of the nut touches the screw, and the balls are circulated from end to end of the nut by a tube, each end of which enters the ball-way between the threads of the nut and screw. As the balls emerge from one end of the nut they enter this tube, which returns them to the other end of nut, where they re-enter the ball-way, traveling at from 50 to 75 balls a second past a given point. The introduction of rolling friction at a nut and screw is one of the secrets of the high efficiency of this elevator, every part of which in the line of transmission of power from the motor to the car is on rolling friction. For example, the thrust of the screw is on ball bearings, and the multiplying sheaves are on hard steel ball bearings, which with the ball nut, complete the transmission of power.

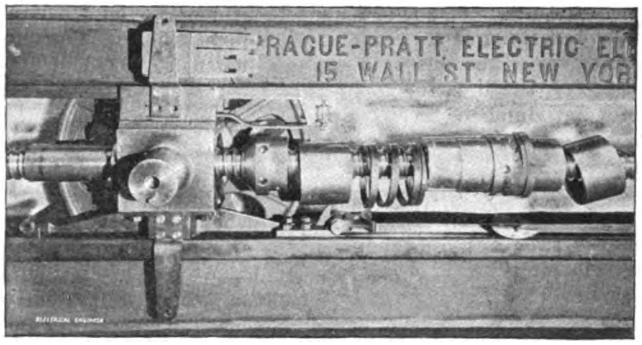

FIG. 7.—PARTS OF NUT SYSTEM.

An interesting test was recently made on a Fairbanks testing machine in New York to determine the liability of balls crushing under normal or extra working strain, and to settle once for all any doubt as to their ability to stand the duty required of them. Ten balls of two different makes were put under crushing strains, and required from 20,000 to 40,000 pounds to break each of them. Since the working pressure varies from 50 to 125 pounds, giving a safety factor ranging from 160 to 880, there would seem to be margin enough to satisfy the most exacting.

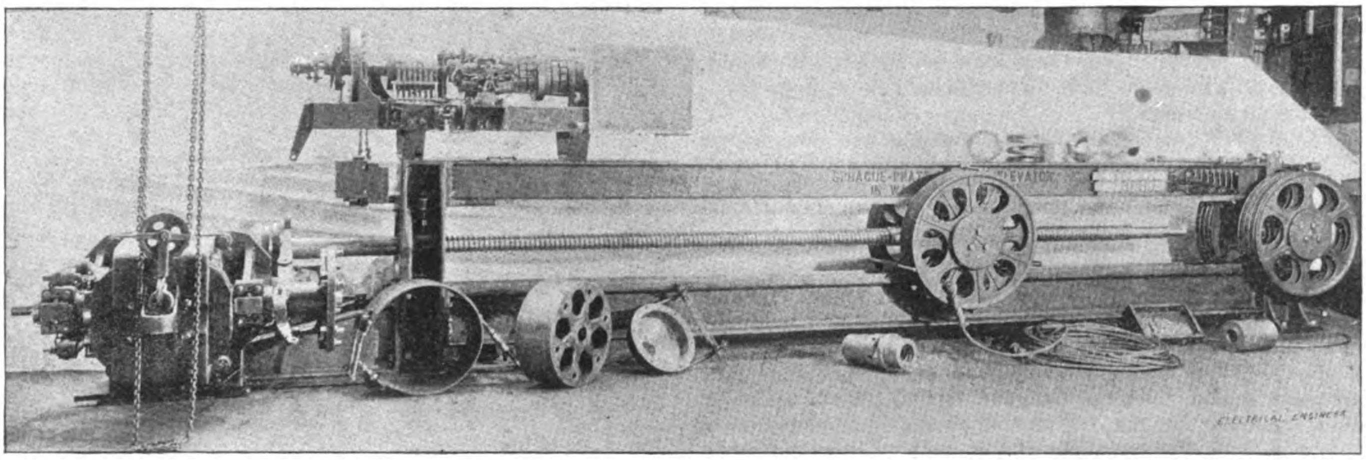

FIG. 8.—GENERAL VIEW OF ELEVATOR WITH PARTS DETACHED.

All those who are familiar with the operation of ball bearings are aware that there are many difficulties to overcome, and these difficulties are such as have led many people to generally condemn the ball bearing notwithstanding its freedom from friction. It is unnecessary to here enter into the the reasons for the many failures, or to explain how difficulties have been overcome in this machine, for these are in the nature of trade secrets. That the difficulties were many is apparent when it is stated that it took over a year to learn how to make the ball nut itself, and the mechanical features now characterizing it and the physical treatment of the metal itself are about as essential as putting the eye into the point of a needle for a sewing machine. There seems to be no other way of getting at the result required except by the methods adopted. So free is this machine from static friction that it is possible to start the car at a very slight increase of current over the normal hoisting current provided time be taken so that the work done in acceleration is small compared to the work of lifting.

Looking at it in a reverse way, the fact that a small weight on the hoisting ropes can overhaul the entire machinery, and revolve the screw, although having only one inch pitch, and promptly accelerate it to several hundred revolutions per minute shows how free from friction the machine is.

Other operative elements will be described later on under the head of Safety.

VI.

THE FUNCTION OF LOWERING INVOLVES:

1st. *A gradually accelerated start independent of the skill or humor of the elevator boy.*

The operation is as follows: The car switch being thrown to the "down" position causes the controlling motor to begin to release the brake at once; the hoisting motor armature terminals being already short-circuited with no resistance in, and the fields separately excited, the moment the brake is released the screw is left under the control of a dynamo with separately excited fields and armature short-circuited on itself, thus forming a resistance which allows the car to move only at a very slow speed. As the switch movement is continued the brake is fully released; more resistance is cut into the armature circuit. and the car is now free to descend more freely because the pressure of the car load transmitted by the multiplying sheaves to the hoisting nut causes the hoisting nut to revolve the screw, and as the controlling motor cuts in more resistance to the armature circuit, the dynamo resistance to the turning effort of the screw is diminished, and the screw revolves faster under the steady pressure of the nut.

As in the start in hoisting this acceleration is capable of any adjustment, but only by this application of rolling friction can any kind of a screw-hoisting machine be made to reverse its hoisting action by simply releasing the brake and then attain a prompt start down and as rapid acceleration of speed as is desirable.

2d. *A gradual stop likewise independent of the elevator boy's personality.*

This condition is necessary in order to avoid straining the hoisting machine as well as for physical comfort, and is attained in this elevator by returning the car switch to the "stop" position, which simply reverses the operation of starting down.

3d. *Control by the car switch that will enable the operator to make the most limited downward movement required.*

This is essential for all refined high-speed work, and the control of this elevator is so perfect that movements of one-quarter of an inch are readily made.

4th. *Any required variation of speed by the car switch for any distance of travel.*

The Twenty-third St. elevator, having a maximum speed of 400 feet per minute, can make a run down of five stories at a speed of ten feet per minute without working the car switch after starting, or can make a run of a few feet at the rate of half a foot per minute, which means a motor and screw speed of three-quarters of a revolution per minute, with the regularity of a clock.

This motion clearly demonstrates the mechanical efficiency and electrical control of this elevator.

5th. *Unlimited speed at an absolutely smooth motion.*

By unlimited speed is meant anything up to about 900 feet per minute. Such speeds would be practical with worm-gear elevators in lowering, but as their capacity for smooth hoisting under heavy loads is practically limited to about 225 feet per minute, it would be impracticable to run them down at four times their hoisting speed.

The absolutely smooth motion in lowering obtained by driving the motor as a dynamo by the weight of the descending car is only possible by using separately excited fields. Suppose the dynamo-motor to be at rest, and either shunt or series wound; when the brake is released and the car load applies its energy to revolve the armature there is no field present to resist the turning effort, and the car is allowed to fall rapidly until the dynamo has built up its own field; it then checks the car quite suddenly, the speed is reduced, the fields weaken and the car speed accelerates again. This intermittent action is repeated all the way down, but with less variations of speed. It would, however, require more than three stories' run to make these jerks imperceptible.

6th. *An easy, absolute, automatic stop at the lower story.*

There are two means of accomplishing this in this elevator. The first is by the simple action of the nut and screw, as follows:

At the end of the screw to which the nut arrives when the car is at the lower story, is placed a spring buffer composed of elastic rubber washers and thin steel discs. When the nut meets this buffer it acts as a brake to slow down the screw, and if the pressure is sufficient, it will, after compressing the buffer about 1½ inches, or one foot travel of car, lock and revolve with the screw, and thus as in hoisting, stop the car without stopping the motor. This stop is no more sudden than is often met with in practice in the best hyraulic elevators, and is absolutely safe and reliable.

In addition to this, for the sake of physical comfort and to save wear and tear on the machine, there is arranged a series of variable resistances, a circuit through which is established by a carbon brush on the traveling sheave cross-head moving over bronze contact plates. The first contact is made at about 6 feet from the lower story, and reduces the resistance so little in the armature circuit that its effect is scarcely felt in the car; from this point to the lower story the resistance is gradually cut out till the armature is short-circuited, and the speed made so slow that the nut which is finally stopped by the spring buffer only compresses it about one-half of an inch, equal to four inches motion of car, and thus forms the softest possible stop.

The softness of this automatic slowing and stopping even when dropping at 400 feet a minute is almost incredible.

7th. *Means for applying the brake in case of any accident to the motor circuit.*

In lowering, this action takes place instantly, as the electromagnet, the same one described in hoisting, has its circuit entirely broken in this case, and the brake is at once applied.

VII.

Safety.—In this connetion consider the hoisting machine apart from all electric and other safety devices.

First, the screw; this is a bar of special forged steel under tension and torsion strains, and capable of sustaining twenty times the heaviest load applied to it.

Second, the hoisting nut; this is of special steel hardened and finished by a special process, and has shown almost no wear whatever in a year's severe run under conditions particularly onerous.

In addition to this is a safety nut. This nut is normally out of contact with the screw's thread; it is secured to the hoisting nut, and should any accident happen to the latter which would break its hold on the screw's thread, this safety nut, the thread of which interlocks with the screw's thread to a greater depth than the thread of the hoisting nut, would then take the place of the hoisting nut, and form an anchorage to hold the traveling sheaves with a grip exceeding the strength of the screw. This would put the elevator out of operation, as the friction between this nut and the screw is greater than the friction caused by the pressure of the traveling sheave cross-head against it; this nut would then act simply as a collar on the screw, and revolving the screw would then transmit no motion to the car. It is obvious that the only part of this elevator that could wear out so as to allow the car to fall if there were no safety nut is the threads of the hoisting nut or screw. Therefore, having a safety nut which is subject to no wear and the thread of which reaches nearer the centre of the screw than does the thread of the ball nut, a condition of safety is reached which is independent of the wearing out of the machine, and also independent of any automatic safety devices. But it may be remarked that special processes of manufacture amply tested by severe duty, insure

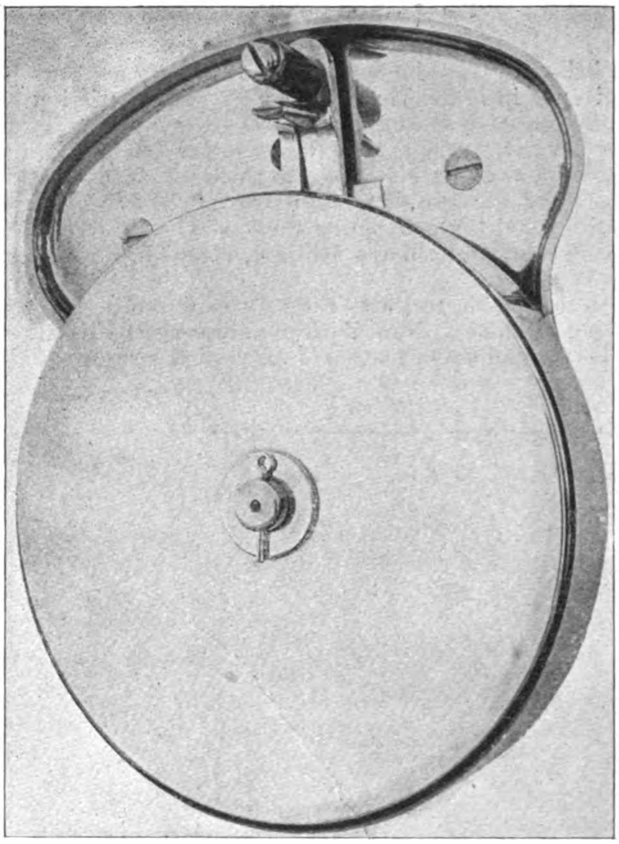

Fig. 9.—Car Switch, Sprague-Pratt Elevator.

an exceedingly low rate of depreciation on the ball nut and screw.

It is moreover evident that if the screw should become free to revolve unchecked by motor or brake, a most improbable conception under normal conditions, the weight of the car would not cause the screw to revolve at such a speed as would be dangerous to life. Then, too, there is the rubber buffer at the lower end of screw to cushion the end of such a run, as already described.

The use of the buffer, as well as the frictionless character of the nut have recently been most effectively illustrated by a very practical test on a large elevator car. In a recently erected plant where passengers were being carried at the same time work was going on on the machinery, on account of the absence of a limit stop three safeties of the machine were one after another thrown out of operation, the current supply was cut off, the locking strap was held back from the brake wheel, and a heavy car, starting from the fifth story of the building, was allowed to run absolutely free without a check of any kind or character except that which might be given by the increased friction of the balls in the operative nut. It quickly attained a speed of about 800 feet a minute, the screw going at 1,200; it then apparently ceased to accelerate, but at this speed the cross-head came against the buffer nut, compressed it, and in a space of about 18 inches in the travel of the car it was brought to a stop within six inches of its normal stopping place without breaking any part of the cables or fastenings and with absolutely no injury to the car and no shock to the passengers. Had a similar runaway occurred on a hydraulic machine the probabilities are that the car would have been smashed to pieces. No more severe test could probably be made upon this safety than the one instanced.

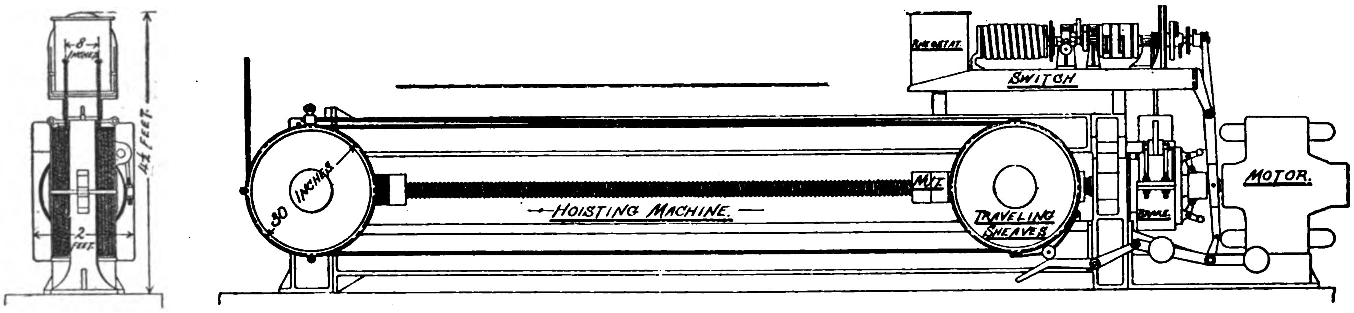

Fig. 10.—Architect's Diagram, Sprague-Pratt Elevator.

All other parts of this elevator are built on the same factor of safety as the screw.

Assuming that the car is perfectly safe for any load that it will be called upon to carry, it only remains to establish an absolutely safe connection between the hoisting machine and the car. Experience has shown that owing to the size and number of hoisting ropes used on passenger elevators, and the care that is taken of them, there has never been an accident due to the actual breaking (other than at fastenings) of the ropes on passenger elevators. This statement has been affirmed by Thomas E. Brown, consulting engineer of Otis Bros. & Company, and by letters from the leading elevator companies to the wire rope makers of whom they buy their ropes.

Ropes, however, have been known to pull out, or break away from their fastenings. This, therefore, is the last point necessary to establish the fact that this elevator is absolutely safe.

The rope fasteners used on this elevator consist of a solid body of metal which has a double spiral groove; the rope enters this groove by being passed through a loop in one end, wound twice in the groove, passed through a loop in the other end, returned in the other groove in spiral convolutions between the first winding and out through the loop in the first end. This engages about three feet of the rope, instead of about three inches which other rope fasteners hold. There is but one way that a rope can be put in this fastening, and it will hold almost any size rope equally well. Tested in Fairbank's testing scales, it took 10,500 lbs. to break a five-eighths inch iron wire rope, which gives this rope a higher rating than the makers give it in their catalogues. The engineer in charge of these scales stated that other rope fasteners usually break the rope at from one-half to three-fourths of the rated strength.

The increased safety factor in the Sprague-Pratt electric elevator is therefore clear. Although approved safeties will be used on every car built by this company, there is only the remotest liability that they will ever be called upon to work. The safety of an elevator should be from the point where the ropes are attached to the car to the point where the hoisting power is applied, assuming of course a perfectly safe car.

VIII.

Contrary to general assumption no elevator is safe which has to depend alone upon the car safeties, no matter how operated.

Car safeties may be divided into two classes, one being that in which the wedges are operated by the breaking of one or more of the hoisting ropes, the other being that in which they are thrown into action when the car accelerates its speed, whether hoisting or lowering, above a certain determined rate. This last is called a centrifugal safety, and may be operated by a centrifugal governor on the car put into play by a rope running the length of the hoistway, or by a centrifugal governor on the overhead beams.

The difficulty with the first car safety is that if for any reason the car runs too fast by any disarrangement of the machinery but without breaking of the hoisting rope the safeties are not thrown in operation, and the difficulty with the latter is that it may be thrown into operation when not desired, and on account of the annoyance of this the adjustment of the safeties is often changed so that they will not be thrown into operation except when there is a great increase of the normal speed. For example, it is practically impossible to stop a rapidly moving car by wedges on wooden guides without so cutting them that it takes not only some time to release the car, but the guides are so badly damaged that a piece has to be cut out and a new one put in. What is the result? Suppose a car should have a normal maximum speed of 350 feet per minute, and the centrifugals should operate when the speed, on account of an extra heavy load, is increased 10 or 20 per cent. On account of the difficulties with the guides, the engineer in charge will change the adjustment so that the wedges will not be thrown into operation until the car is running at, say, 600 feet a minute, that is, long after the allowed excess of speed has been reached. Since the momentum increases with the square of the velocity it is a much more difficult matter to arrest the movement of the car and even if arrested the stop is by no means a pleasant one.

Another difficulty with the centrifugal governor, whether on the car or on the overhead sheave beams, is that on account of its apparent inaccessibility it is often neglected, becomes gummed up, and when needed is found to be inoperative.

Despite the difficulties which have arisen with this kind of centrifugal governor the high-speed car should have something of the kind.

But it should be a governor which is always in order, which can be thrown into operation with only a reasonable excess of speed over normal, and it should be readily accesible. This by the very nature of things can only be the case when the centrifugal governor forms a part of the operating machinery and is not dependent upon the ropes attached either to the car or the counterweight. The safeties operated by these elements should be brought into play only in case the normal safeties attached to the machine fail to operate. Hence in this electric elevator, no matter what car safeties are used, there is a centrifugal safety depending upon the speed of the driving screw which is made operative at any determined excess of speed, and when operative stops the car by checking the hoisting ropes.

Such a centrifugal is under the constant supervision of the engineer, it is always ready for operation, and if there has been no accident, but simply an increase of speed above that for which it is set, it can be instantly restored by the controlling switch and leaves the car free for operation, acting again promptly in case of any undue acceleration. The result is that even on short runs the centrifugal safety on this machine can be thrown into repeated operation without shock or jar and the car immediately set in operation again. This is an absolute impossibility with a hydraulic elevator, which has only such a safety on the car itself.

IX.

Not the least important consideration in replacing the hydraulic by this elevator is the

Economy of Space.—The Sprague-Pratt express elevator when supplied from a central station occupies only from one-tenth to one-third the space occupied by a hydraulic plant of equal capacity.

This fact has been established by strict comparison with diagrams showing the actual measurements of the space occupied by several representative modern plants of equal capacity now in operation in New York City, and put in by such well-known makers as Whittier of Boston, Crane of Chicago, and Otis of New York.

One very great advantage of the electric elevator is that it can be placed wherever required by the architect, either in the basement when it forms a small part of the total operative machinery in the building, or at some intermediate place, or upon the roof. This latter seems, and is, a radical departure from existing elevator practice, but it is undoubtedly going to become a well-accepted practice, especially where there are a nest of elevators operated and where the basement space is more valuable than that which would be occupied by the machine on the roof.

It is manifestly impossible to put a hydraulic machine on the top of a building, for of the three systems now generally adopted the tank system on the roof would have to be abandoned and either a direct system of pumping or a compression tank used. If the pump is in the basement, then the water would have to be pumped against the additional head due to the height of the building, and if on the roof the steam would have to be carried to it. Both plans are impracticable.

Any one wishing to estimate the space that this elevator would save in his own building, may, after measuring his hydraulic plant, or plans for a proposed hydraulic plant, as the case may be, estimate the space that the elevator would occupy, as follows: Measure the distance in feet that the car travels, divide it by the number of multiplying sheaves on the crosshead, and to that add 13 feet. This gives the length of the elevator machinery over all. Allow 2 feet for its width the entire length and 3 feet 6 inches for its height. This gives approximately the space required for this elevator. It can be located anywhere that it is possible to lead the ropes from it to the car over proper sheaves.

A vertical cylinder machine has often been preferred in order to save basement space; in this connection it is important to state that this elevator, although resembling the horizontal hydraulic machine, occupies less space than the smallest possible pumping plant alone of the vertical cylinder machine of equal capacity. One material advantage obtained is the saving of the space occupied in the shaft way by the cylinders and sheaves all the way up the building, and also to confine all such machinery and apparatus to a place where it can be most effectively cared for.

The value of the space saved varies with the conditions of the building. For instance, where safe deposit vaults occupy basement space the first cost of this elevator might be paid for in one year's rentals of the space saved.

In an office building the absence of the noise, odor and heat of a steam pumping plant, and the substitution of this elevator, leaving only a low-pressure boiler to heat the building in the winter, would make the basement habitable, and the space thus saved would accommodate one or more good offices.

It has in any case the indirect value of increased coal or other storage capacity and greater comfort in warm weather, when with this elevator no fires would be required.

X.

Realizing that in no electrical application need more care be taken than in the operation of electric elevators, in other words electric railways running on 100 per cent. grade, the utmost care and study has been given to this system before any public description of it has been permitted. No one could risk his reputation, nor the public its capital, unless the soundness of the principles involved and the perfect reliability of the machine were fully demonstrated. It was necessary not only to prove that there was a distinct gain in economy, a saving in operating expense for the same duty, and in the space occupied by the elevator, but its safety must be so far beyond question that come what may, either in the way of failure of current, breaking of some part of the mechanism, attainment of abnormal speeds, or gross negligence and carelessness on the part of the engineer, the safety of the people in the car must be assured. It is believed that this has been attained.

The work of the development of this machine has taken nearly four years. It embodies the labors of a number of people familiar with the questions involved. For a year there has been in operation on West 23d St., New York, the first of these machines, running about 250 feet per minute, and supplying freight and passenger service on both sides of the elevator for a five-story building. About every kind of accident or breakdown has been intentionally put into operation on this machine, and even almost vicious attempts made to wreck it, but as yet there has been no disastrous esult to record. It has even passed successfully through a fire. Having determined on this machine, all the essential elements, there has recently been put into the Grand Hotel, at 31st street and Broadway, a machine of similar type, but on an improved model, on more severe duty and under circumstances which are certainly not to be considered as experimental. This elevator has a double-decked car 6 feet square and about 16 feet high, weighing without the counter-weights about 2,300 lbs. It has a normal speed of about 250 feet a minute, and changes can be readily made to increase this speed to 450 feet per minute. It is now on duty 18 hours and will soon be on duty 24 hours a day the year around. There is no relief, because there is no other elevator in the building, and it affords the only way, except the stairways, of getting to the upper floors.

Following close upon the beginning of this operation the most important elevator contract at present signed in the city of New York has been awarded this system. This contract is for a nest of six high duty elevators in the Postal Telegraph building at Broadway and Murray street. This building is 14 stories high; the elevators, four of which are way, with a capacity of 325 feet per minute with a live load of 2,500 pounds, and two express having a capacity of 400 feet per minute with a load of 1,800 pounds, have a run of 165 feet, and the service will vary from 10 to 24 hours per day. Since the main offices and operating-rooms of the Postal Telegraph Company are on the upper floors, and the building has an annual rental of about $200,000 a year, this contract likewise prohibits experimental conditions. The elevator machinery will be in the basement, the two express machines, on account of the lack of space, being set crosswise on the way machines. This is the first of the larger contracts and as this article goes to press there are others which are crowding on.

Of course the manufacture of apparatus of this kind requires high class mechanics and the best class of machinery. From the standpoint of the manufacturer, the tools which form a part of the shop equipment now being gotten together for this work would prove interesting, as there is probably not in the United States an equipment of higher character, nor one better arranged for accurate, reliable and rapid output.

ELECTRIC COOKING AT OTTAWA, CAN.

Some of the work done at Ottawa, Can., lately with the Ahearn electric heaters and cookers has awakened considerable interest all over this country. These heaters, the invention of Mr. T. Ahearn, of the firm of Ahearn & Soper, have passed under the control of the Railway Equipment Company, of Chicago, and are to be vigorously introduced wherever the conditions are favorable. In Ottawa the cheap supply of current from the Chaudiere Falls has been an incentive to the use of electric heaters, but there are many places where the conditions of convenience and safety are such as to warrant their employment even with current at the ordinary city rates.

To illustrate what could be done, a dinner was given last August to 100 guests, at the Windsor Hotel, Ottawa, when a menu of several courses and some 30 dishes was provided. All the meats, including a 21-pound roast of beef and a 13-pound roast of veal, as well as three big turkeys, were cooked at the same time, and not half the oven space was occupied. The inside measurement of the oven used was four feet square, the ceiling being arched. There were two electric stoves in the oven, and the current consumed by the two was 43 amperes at 50 volts, or about 3 h. p.

At the Central Canada fair this month (October) a similar demonstration on a larger scale has been made by Mr. R. E. Jamieson, a local baker and confectioner of renown. We illustrate the exhibit. The oven was built of 16-inch walls on a stone foundation; the cooking space was four feet square; the ceiling was arched. Three stoves were placed below the floor, and were controlled by the switches shown on the top of the oven. The floor of the oven was made of iron gratings with a 6-inch air space beneath the grating for the heat to circulate under the bake-pans. At the rear end (not shown in cut) was placed a peep hole 16 inches long by 6 inches high, of three thicknesses of plate glass slightly separated to prevent induction of heat from within, to allow visitors to inspect the process of baking, the interior of oven being whitewashed and lighted with incandescent lamps. The current used was supplied by two 40-light Westinghouse converters, the quantity consumed by each stove being 20 amperes at 50 volts. Ordinarily two stoves are sufficient for an oven of this size, but a third was added to this exhibition outfit to compensate for the inordinate opening of the oven door.

No fewer than 12 pans were going at a time, people waiting their turn in crowds. The electric buns were sold at the rate of 25 cents apiece, a price that must have gladdened the thrifty soul of Mr. Jamieson and should be a great inducement to other bakers in other cities to avail themselves of like opportunities. "Went off like hot cakes" now reads in Ottawa "went off like electric cakes."

The oven was equipped with pyrometer, turn-off switches, clock, etc., and was the attraction at the fair. Mr. Ahearn was awarded a special gold medal for the display, which included, also, house heaters, coffee boilers, and special heaters for the restaurant in the main building for cooking food.

The Ahearn apparatus, so far as shown, is generally cylindrical in form, consisting of inner and outer tubes of iron, upon which resistance coils of German silver wire, protected by asbestos, are wound. Vacant spaces are filled in by powdered whiting.

Baking Cakes by Electricity at the Ottawa Fair.

PRIZE FOR A MICROPHONE.

Nature, of London, announces that Baron Léon de Lenval, of Nice, offers a prize of 3,000 francs to the inventor of the best application of the principles of the microphone in the construction of a portable apparatus for the improvement of hearing in deaf persons. Instruments for competition should be sent to Prof. Adam Politzer, or Prof. Victor von Lane, Vienna, before December 31, 1892. The prize will be awarded at the Fifth International Otological Congress at Florence, in September, 1893. If no instrument is judged worthy of the prize, the jury reserves the right of announcing another competition, unless Baron Lenval decides to dispose of the prize otherwise. The following are the members of the jury: Prof. Adam Politzer (president), and Prof. Victor von Lang, Vienna; Dr. Benni, Warsaw; Dr. Gelli, Paris; Prof. Urban Pritchard, London; Prof. St. John Roosa, New York; Prof. Grazzi, Florence.

INSURANCE INSPECTION IN THE MIDDLE STATES.

Attention is drawn to the notice on advertising page xii, of this issue, in which electrical contractors doing business in the Middle States are requested to correspond with the secretary of the Underwriters' Association, 316 Walnut street, Philadelphia, with regard to installations in that territory.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can :entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. XIV. NEW YORK, NOVEMBER 2, 1892. No. 285.

The application of science to the arts and industries is to but one purpose—to get the greatest return for a given amount expended.—David Brooks.

THE FARMER AS A RAILROAD KING.

IT is worthy of note that a convention was held recently in Chicago to form an association which should improve the country roads of America. The object is one that must win universal applause; the means to be adopted, and the exact nature of the end sought, remain fit topics of discussion and criticism. There can be no question that, on the whole, country roads are in a bad condition, and by "country roads," we mean highways as well as byways. Just how wretched they are no one realizes more keenly than the bicyclist, enthusiastic over the idea of running his wheel from one great city to another, for his experience is not local like that of the farmer, but takes in a good many counties and more than one State. Here and there, the roads are hard and smooth, affording easy travel; but by far the largest number are soft or rough, and transportation over them is painful and expensive. It is estimated that, as a result, the farmers of the United States are keeping 2,000,000 horses more than would be required if the roads were good; and the loss to the farmers is put at $500,000,000 annually, due to their upkeep of the horses, wear and tear, and sacrifice of produce.

To replace the bad roads by good, it is proposed to raise money on issues of county bonds. That being the case, we would like to suggest that the best thing the farmers can do is to go in heartily for electric roads. We may be wrong, but our conviction has long been that in the resort to electricity lies a solution of the country road problem, so far as the transportation of produce is concerned. What is needed is simply to get produce quickly and cheaply to the nearest point of shipping or of consumption, and there can be no quicker or cheaper way than of running it over a track. In fact the highway without a track on it will soon be looked upon as a relic of barbarism, not worthy of being considered as a part of the system by which civilization holds together.

A curious instance of the tendency in this direction was afforded the other day by a rancher at Farmington, Cal. He has a big ranch, and during the past season did all his ploughing with an engine, running it night and day with three shifts of men. After the grain was threshed he had 30,000 sacks of grain to haul to the railroad for shipment to Stockton, a distance of seventeen miles, at an expense of $1.10 per ton. Instead of loading up his wagons, hauling to the station, and unloading into cars, he simply hitched nine wagons to his engine, loaded up in the field, and hauled along the road to Stockton, requiring five hours for the trip, the only expense of hauling the forty-two tons being the wages of three men and the coal used. Now, what was done in this way with a ponderous traction engine on a soft dirt road, would be infinitely easier with a light electric trolley system, and ought to be a good deal cheaper.

The construction of these country trolley roads would not be expensive, and their tracks would afford smooth travel for other than the trolley motor and the trolley freight trucks. The supply of motive power is not a difficult problem. To-day a large portion of the American farming area is within touch of the 500 towns and cities that now enjoy trolley traction. Elsewhere a large portion lies adjacent to cheap coal or cheap water power. And even where the supply of current would appear difficult, the enhanced value given the farm lands that could ship away their produce promptly, would come in to meet the exigencies of the case. Moreover, the very ease in handling delicate products quickly would invite to a diversification of crops of greater value.

It might be said that a steam road would do all that a trolley road could do. That is not true, whether in regard to the cost of the installation, the simplicity of the apparatus, or the expense of operation. On the contrary, the main lines of steam railroad have been waiting for just such feeders as these trolley roads will prove to be, while many of the shorter steam railroads that have already absorbed all the old functions of the highway would be more profitably run, if they were at once converted into electric roads. If anybody thinks we are wrong about this, we hope they will quote it against us five years hence. Meanwhile the signs of the times seem to us such that, on the basis of mileage of electric track operated, we expect to see the farmer a railroad king before this decade runs out.

THE IMPOSTOR SHOULD BE NAMED.

IN an able paper prepared for the Fire Underwriters of the Pacific, Mr. Geo. P. Low, the electrical inspector of the Pacific Insurance Union, mentions the case of a theatre wired for incandescent lamps, where Grimshaw was specified. During his absence, the work was done, and on his return he found all the wire at the outlets and open portions to be all right. On a written assurance that the work met requirements, it was accepted. Some time after, the theatre underwent reconstruction, when it was found that of the 9,757 feet of wire taken from the building, only 2,520 feet was Grimshaw. The remainder was ordinary weatherproof, a grade that is condemned for concealed work. The evidence of guilt was ample, for the wire showed that short pieces of Grimshaw were spliced on at the terminals and outlets.

Such a case is a disgrace, and yet Mr. Low says that this impostor is still in active business. Something should be done to expose a man who thus imperils life and property and brings contempt on an honorable profession. If Mr. Low will send us the man's name, we shall feel inclined to publish it in big black type.

A DEPARTURE IN ALTERNATING CURRENT PRACTICE.

The detailed description which we gave in our last issue of the new 500 h. p. direct connected Westinghouse alternator now being installed in the station of the Narragansett Electric Light Co., at Providence, R. I., deserves more than passing notice, as it marks a distinct departure in two directions in the alternating current practice in this country. In the first place the alternator constitutes practically the first large machine of this type connected directly to the shaft of the driving engine, a practice which has just been inaugurated with continuous current dynamos in this country, but which is no novelty in England or Europe. The connecting of the alternator to a slow speed engine naturally called for a modification in frequency of alternations, and in this respect, also, a wide departure has been made from the practice heretofore embodied in the Westinghouse apparatus. The reduction from 133 periods per second to 60, will bring about important improvements in the alternating current field, as the reduced number of alternations while well adapted to lighting is especially applicable to the operation of alternate current motors, whose self-induction will thereby be largely diminished.

LAMP PROSPECTS.

Curiosity and interest in electric circles are perhaps pretty evenly divided between expectations touching the policy of the General Electric Company under the recent decision in the Edison lamp case and respecting the promised early advent to the market of the new Westinghouse lamp. General attention has been drawn to the announcements of the Westinghouse Company that their lamp does not infringe the Edison patent, that its price will be so low as to be a surprise to all users, and that their price list will be forthcoming in November. Under a large reduction in existing prices of lamps and with the ability on the part of consumers to have the filaments replaced, preserving the remaining portions of the lamp, the cost of lamp supply and renewal—a very considerable portion of the running expense of a station—should be greatly reduced. We have heard the saving in this regard by the Westinghouse Company in lighting the World's Fair for six months estimated as high as $50,000. A minor point of interest in connection with a removable carbon is that it may stimulate the use and production of ornamental bulbs since they can be used for an indefinite period instead of being destroyed with the carbons.

ELECTRIC MOTORS FOR THE FARM.

In the West steam power is used by the farmers to a large extent for threshing grain, and in Manitoba several disastrous fires have been caused by sparks from this source. The *Winnipeg Commercial*, in a recent editorial drawing attention to this, says that every farmer who employs steam threshing appliances runs a serious risk of being burned out, and as a remedy advocates the substitution of electric power, for then the engine and boiler for operating the generator could be placed at a safe distance from combustible material and the power transmitted to where the threshing machinery was located. We commend this idea to the attention of Prof. G. D. Shepardson, at Minneapolis, and Prof. R. B. Owens, at Lincoln, Neb. The question is one that has peculiar and special interest for the States in which they officially represent electrical engineering.

THE SPRAGUE-PRATT ELEVATOR SYSTEM.

After all, it is but natural that Mr. Frank J. Sprague, seeking fresh fields and victories new, should exchange the comparatively easy problems of street railway traction for those of elevator service, which represent an electric road with a 100 per cent. gradient. The result of his work in the perfection of electric elevators is stated in this issue by Mr. Sprague himself and his able co-inventor, Mr. Pratt, who has long made a special study of elevator operation. The system adopted by them is that of the screw and nut, as fully explained in their most interesting article. Whatever Mr. Sprague says and does is regarded as worthy of most serious attention, and it would appear that the Sprague-Pratt elevator as here described marks a not less important advance than that which was made on the steep red hillsides of Richmond.

"Last Call to Dinner"?

A circular, received a few days ago, offers perhaps the last opportunity of achieving fortune through the investment of a few dollars in the stock of the "Pennock Battery Electric Light and Improvement Company." The par value of the shares is $1. They are offered now at a premium of only 900 per cent.—the price is $10—certainly dirt cheap in view of the $30,000,000 to $50,000,000, expected to flow into the treasury from sales of State rights.

Of course the General Electric, Westinghouse and other companies, will not last long under competition with the Pennock System—for who will buy "the old-fashioned dynamo system" when the Pennock people will light you (brilliantly) 1,000 electric lamps cheaper than the old fogies who continue to make dynamos can light (faintly) 100 lamps? There have been primary battery schemes a-many, but heretofore none so glowing as Mr. Geo. B. Pennock's.

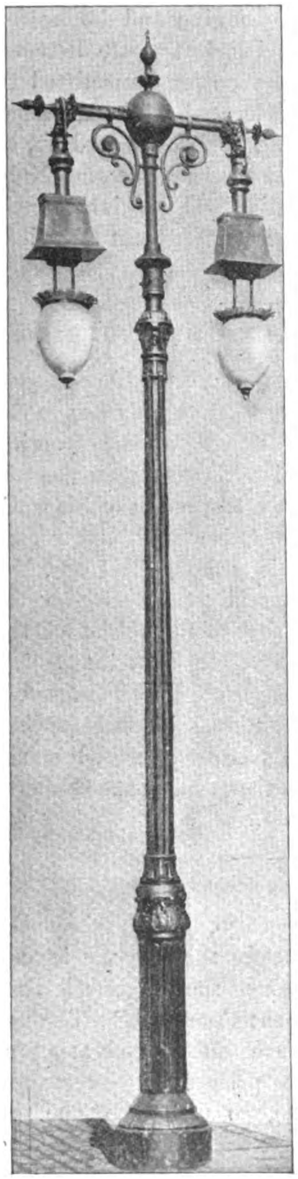
The Cheapness of Platinum.

It is a curious fact, in connection with the present discussion of incandescent lamp manufacture, that platinum has not been so cheap as it is to-day since the very first production of the incandescent lamp. This is at once significant and encouraging.

THE LIGHTING OF FIFTH AVENUE, NEW YORK.

BY

Jos. Wetzler.



The New Arc Lamps on Fifth Avenue.

HE Columbus celebration, while it called into existence numerous temporary electric lighting effects of great beauty, also witnessed the inauguration of a method of street lighting which, we are not mistaken in asserting, embodies elements that will make it a favorite one wherever it can be applied. We refer to the illumination of Fifth Ave. in New York by arc lamps, taking current from the Edison low-tension street mains, and the method employed deserves more than passing consideration.

We may premise here that shortly after arc lighting by the series system was introduced in New York, Fifth avenue was illuminated by it, and continued to be so up to the time that the crusade against overhead wires culminated in their removal. When the series arc-lighting companies were compelled to go underground the heavy rental of the conduits made the lighting of Fifth avenue unprofitable, as very few private arc lights are used on that street. High tension conduits were laid only between 23d and 42d streets, and these were not utilized for street lighting. The upper part of the thoroughfare returned to the gloom of gas, and the lower part still had overhead wires.

Upon the approach of the Columbus celebration the authorities were petitioned to relieve the upper portion from its gloom, and the height of the "floats" prepared for the night pageant required the removal of the overhead wires. The Mayor was averse to the re-opening of the pavement, and the engineer of the Board of Electrical Control was directed to ask the Edison Company if it could not provide street lighting from its mains. The conditions absolutely forbade the stringing of any overhead wire, or the use of an underground bridging conductor between the lamps on successive posts. The ordinary method of connecting low-tension arc lights in series could not therefore be utilized, but the problem here presented was solved in a very neat manner by Mr. R. R. Bowker, first vice-president of the Edison Electric Illuminating Co., and the lamps have been in nightly operation since the Columbus celebration, extending from Fourth up to Fifty-eighth streets.

The essential feature of the new system is the employment, instead of a single arc lamp, of a pair of arc lamps on one post, each lamp taking five amperes at the usual arc-lamp voltage, approximating 50 volts. By this arrangement practically the same amount of energy is used as in the single arc lamp on a high tension in series circuit, but it has the double advantage of permitting connection with the Edison mains through the ordinary house service, without running any special circuit or connecting wire from post to post, and of giving a more effective light, of better diffusion, so that absolutely no shadows are cast, thus avoiding a chief objection to the ordinary street arc lighting.

The accompanying engraving shows one of the ornamental posts employed. It is made in three parts, the base, the shaft and the arm section. The resistance, instead of being placed in the hoods of the lamps, is provided for within the base, and the lamps are raised and lowered from within the shaft, access being had by a door which opens in the base, the key of which is carried by the trimmer. The lamps are fed by a sliding contact in the hood, so that when the lamps are lowered they are automatically cut off from the current and are absolutely dead. No climbing of poles is required by the trimmer, and there is no chance of obtaining even a low-tension shock when the lamps are trimmed. The current, as remarked above, is supplied from the Edison mains by the ordinary house-service method, the supply wires running through the gas pipe which forms the centre part of the shaft. The hoods and the posts are of a highly ornamental pattern, and the type of lamp adopted is a new arc lamp developed by the General Incandescent Arc Light Co., of which Mr. S. Bergmann is president.

The new system, which will be patented, is unlike any thus far employed, either in this country or abroad, the Unter den Linden lighting in Berlin, to which it has been compared, being quite dissimilar. There, single arc-lights, which have to be connected "in series" with another light beyond by an overhead or underground special wire, are suspended over the central promenade from uprights on either side, these being supplemented by side lights along the house fronts. The device of placing two arc lights together on one post with self-contained resistance, though simple enough, does not seem to have been before developed; and it makes possible for the first time a street-lighting system by which individual lamp-posts can be lighted from low-tension mains by the ordinary service connection at any place along a street where there are low-tension mains, without connection with other posts. All the features of the new system are not yet developed, as it was the special desire of the Mayor and the city authorities that the whole of Fifth avenue should be lighted by the new system before the Columbus celebration, which left no time for experimental work.

EARTH TROUBLES FROM TROLLEY SYSTEMS.

BY P. HOLCOMB.

SOON after the trolley appeared in Atlanta earth troubles were felt by the telephone people. The telegraph wire chiefs next noticed them while testing for conductivity. Now the system has grown and the leakage has increased till one can see the effect on a short-distance quad. The current is always of zinc polarity, lasts about half a minute and occurs at two-minute intervals during the middle of the day. A No. 6 wire from Atlanta to Macon, grounded at both ends works readily by ordinary Morse relay. Also a No. 12 copper to Charlotte, N. C., 267 miles. Any 1,000 ohm circuit grounded at both ends shows a current varying between 2 to 20 milliamperes. The Postal Co. also finds the same leak on its wires. Various grounds have been tried in different parts of the city and an insulated wire run to the bottom of a well, but no better results have been obtained. An experimental ground made at the river, however, eight miles distant, shows no escape.

INSULATED ELECTRIC CONDUCTORS.[1]—XII.

BY

James Brewster Williams M.E.

The expression "painted wires" is generally used to designate insulated conductors, the dielectrics of which are formed of cotton fibre saturated with paint. To this class belong fireproof and some weatherproof wires. These last named, however, are used chiefly for convenience of description, since all fireproof wires should be weatherproof as well, but weatherproof wires are not always fireproof.

Fireproof Wires.—The underwriter's wire is an example of this class. The principal reason for their manufacture was to provide wires with coverings which would not allow fire to run along them when from any cause such coverings might become ignited; in other words, to produce wires having uninflammable dielectrics. Insulation, if judged by results, appeared to be a secondary matter. The manufacture of wires with dielectrics which are at the same time fireproof and highly insulating is almost an impossibility for the reason that the material which renders the dielectrics noncombustible, possesses, as a rule, poor insulating qualities. Further, fireproof dielectrics, *i. e.*, those which are not soon injured by fire and will not burn with a flame, are quite brittle and crack when bent, thus allowing moisture to have free access to the conductors.

Even when asbestos, which is one of the best incombustible fibrous materials, is used as the body of the covering, there must be some kind of a filling for the interstices of the fibre and this filling material, to be fireproof, must have a large quantity of incombustible matter incorporated with it or be composed entirely of such matter. In either case the filling will have poor insulation or will crack when the wires are bent.

Cotton may be rendered uninflammable—although it will char—by soaking it in a solution of pure tungstate of sodium; but the presence of the sodium salt in the cotton will cause the specific resistance of this prepared fibre to be much lower than that of clean, dry cotton. Besides, the salt will readily absorb moisture when exposed to air. If oil is used as the vehicle for the fireproof material to fill the interstices of any fibrous covering, whether this material be powdered silica, mica, asbestos, or other mineral substance, the oil itself will burn unless it has a large quantity of some fireproofing salt mixed with it.

If asphaltum, which contains much petroleum or a flexible petroleum residue, is used for a filling it will require several times its weight of tungstate of sodium to be added to it to render it uninflammable; but the addition of the salt virtually forms a new composition which is neither flexible nor anhygroscopic. In fact, all substances and compositions, such as oils, resinous bodies, rubber, etc, which possess good insulating properties, require the addition of so much foreign material to fit them for use in fireproof dielectrics that flexibility, one of the essentials of any material for use with fibrous coverings, is almost, if not entirely destroyed.

Almost any dielectric having fibre for its basis will resist fire better if the dielectric is made compact and solid around the wire by means of heavy pressure.

It is to be understood that by a fireproof wire is meant one, the entire covering of which is formed of the same insulating materials, and that the covering should be moisture-proof. An absolutely fireproof covering could be formed of asbestos fibre alone but unless the spaces between the fibres were filled with moisture-proof insulating material such a covering would, except in very dry weather, readily admit moisture to the conductor and a current of high voltage would escape through the covering to any bodies connected with the earth with which the covering might come in contact. Almost any insulating covering can be so protected that it will not burn with a flame by tightly and completely enveloping it with asbestos fibre or other incombustible sheath.

The manufacture of fireproof wires will be understood from a description of that of the weatherproof wires, so that the manufacture of the former need not be described here.

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[1] *Copyrighted 1892, by J. B. Williams.*

EMPLOYEES' MEETINGS AT QUEEN & CO.'S LABORATORY.

BY

Percival A. Mitchell

Among the many novel features of the laboratory of Queen & Co., at Ardmore, Pa., is one lately introduced by the superintendent, Mr. Elmer G. Willyoung, which promises to be an instructive success. The idea is to hold at the laboratory, in the evenings, a series of bi-weekly meetings which the employees are invited to attend, and at which all subjects of interest in the electrical field are brought up for discussion.

Those who attend the meetings are divided into committees, whose duty it is to read up the various electrical periodicals, with which the laboratory is well supplied, and to report all articles and points of interest; even the French and German magazines are translated for the benefit of those who would otherwise be unaware of the progress of electrical science across the ocean.

Progress and development of and interesting points concerning work being carried on in the several departments of the laboratory are reported, questions are freely proposed, and no subject is dropped until a satisfactory explanation has been obtained and thoroughly understood by all those present. The meetings are held in the office of the laboratory on alternate Monday evenings. In the room is the library of electrical reference books and periodicals, and a large blackboard with both white and colored crayons is provided for the purpose of graphically presenting new ideas and also for illustrating the communications which are read. At the meeting, held Monday evening, October 17, Mr. Nelson H. Genung commenced a series of interesting talks on the theory of magnetism.

The main object in view is mutual improvement, and the development and perfection of new ideas, and if the present interest shown by the employees continues, there is no reason why it should not be achieved.

BRITISH POSTAL TELEGRAPH FIGURES.

During the financial year 1891-92 over 57,000,000 ordinary inland telegrams were transmitted; an increase of nearly 6 per cent. on the number for the previous twelve months. The annual value of each telegram dispatched has, however, come down from 7.87 to 7.77d, the total receipts from inland telegrams for 1891-92 being £1,848,974. The total number of telegrams, of all sorts, which were dispatched last year amounted to nearly 70,000,000, and brought in two and a quarter millions sterling. Taking telegrams of all sorts, the increase for the past year is only about 5 per cent. The receipts from the London-Paris Telephone for the first year of its existence have amounted to £4,616, and the number of conversations in April last was nearly double the number which took place in April, 1891.

Chicago Electrical Association.—The regular meeting was held on Tuesday, Oct. 25th, at 8 p. m., at the Atheneum Building, when a paper upon "Some Considerations upon Storage Batteries" was read by Mr. E. G. Hovey.

ELECTRIC RAILWAY DEPARTMENT.

JOINTLESS RAILS.[1]

BY

Townsend Wolcott.

The paper of Mr. A. J. Moxham on jointless rails, read at the meeting of the American Street Railway Association,[1] is very interesting, as confirming, and bringing before the public a fact, or supposed fact, of some antiquity. In Trautwine's Engineer's Pocket Book, edition of 1874, page 391, we find: "It is a remarkable fact, not satisfactorily accounted for, that when lengths of from 100 yards to some miles of rails have been perfectly welded or riveted together tightly and spiked to the ties as usual, no elongation or contraction by heat or cold could be detected."

This refers to the ordinary construction of steam roads, the rails being held in no way except by being spiked to the ties as usual. The above quotation is omitted from the later editions of Trautwine, as though the author had lost confidence in the authenticity of the alleged fact. Mr. Moxham's experiments, however, would seem to show the possibility of holding the track, and it remains to be shown by practice whether the additional difficulties which Mr. Moxham himself mentions, of laying and keeping in repair long stretches of jointless rails, are not very serious obstacles to their use.

DYNAMO DRIVING AND THE PERFORMANCE OF RAILWAY ENGINES.

BY

A L Hunt.

In the description of the new station of the Lowell and Suburban Street Railway Co., contained in the Engineer, of Oct. 12, I notice a statement that I do not think is quite correct. It is claimed by Mr. Shaw that the arrangement of generators is quite new, one belt driving two generators, both being mounted on the same bed-plate, etc. Now, some time in the fall of 1890, I had occasion to visit the power station of the Troy and Lansingburg Railway Co., at Lansingburg, N. Y., and saw there an arrangement of generators practically the same as used at Lowell. The engine was a "Greene," made by the Providence Steam Engine Co., and would indicate about 350 h. p., at 120 revolutions per minute, which was about the speed at which it was running. It was belted direct to two Edison railway generators, which were mounted upon a base plate common to both, with the pulley between them, and a flange coupling on each armature shaft, to disconnect, if necessary. Another generator was belted from the same engine, and stood a little ahead of the others, at one side. Of course the fact of there being flange-couplings instead of friction-clutches, in use, was somewhat of a detriment, at times, but those in charge were very well satisfied with the operation of the plant. Plans were being made at that time, for a larger station, to be built in the spring of 1891, and the generators were to have friction-clutches, but I cannot say, whether the station was ever built or not, as I have not been there since.

As an instance of what underloaded engines will do on a pinch, let me relate what took place at the Belt Line power station in Utica, N. Y., on the day that the "Masonic Home" cornerstone was laid, some time last fall. The crowd was the largest ever seen in this city, and the "Belt Line" carried something over 30,000 people during the day, at 5 and 10 cents a head. This was done on a consumption of about 8½ tons of mixed coal worth $1.90 a ton, while the amount used ordinarily was nearly 7 tons a day. This seems to me a pretty fair showing of what mistakes were made in designing power stations some time ago. This station is equipped with three cross-compound condensing, high-speed engines, that are rated at 200 h. p., with ¼ cut-off in the high pressure cylinder, which is supposed to be the most economical point. Two 60 K. W. generators were driven by each engine at the time of the performance alluded to above. Here is an instance where, in order to work the engines at anywhere near their economical load, the generator must be considerably over-loaded. This whole station, by the way, was supplied with steam from two 6 x 16 foot boilers, with natural draft.

THE NEW POWER HOUSE OF THE CENTRAL ELECTRIC RAILWAY CO., BALTIMORE, MD.

BY

A. K. McCay.

The Central Electric Railway Co. followed close on the heels of the Baltimore Traction Co. in signing a contract to convert their line from horse to electric traction. This line extends from the southeastern corner of the city to the northwestern, then running north for about a mile and a half through the older portion of the city; turning east it courses through the most fashionable and wealthiest part of the city for two miles. In its course from east and west it crosses nearly every other street car line in the city; then it turns north again and runs within two short blocks of Baltimore's main pleasure ground—Druid Hill Park. The total length of line is about six miles, and its success as a horse car line will, no doubt, be fully sustained as an electric line.

The arrangement of the station is shown in the accompanying plan and section, Figs. 1 and 2. It consists of three compound engines, made by McIntosh, Seymour & Co., of 250 h. p. each. These are belted to three multipolar compound Thomson-Houston generators. The switchboard is of slate, and is of handsome design and finish. The boilers are of the Campbell-Zell water-tube type. They are so arranged that two constitute a battery, while the remaining one will be used as a reserve. It is intended, should another boiler be added, that the odd one will be connected with the new one, forming two batteries. The normal capacity of the three is 675 h. p. The stack for these boilers is 6 feet 6 inches in diameter and 110 feet high. The masonry on which it stands is 15 feet high, making the stack 125 feet above the boiler-room floor.

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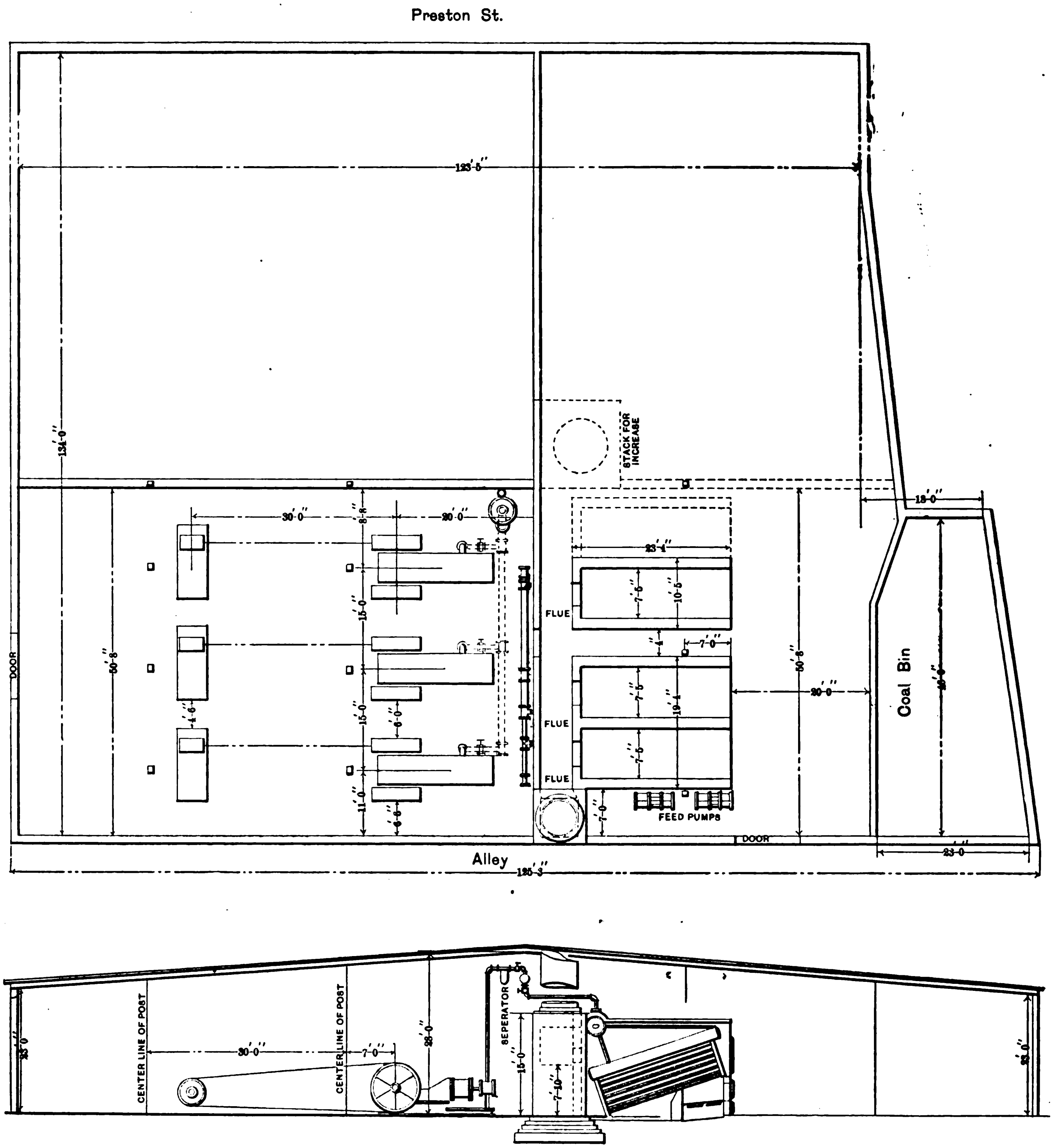
[1] See The Electrical Engineer, Oct. 26, 1892.

The road will begin with twenty 16-foot Stephenson cars, mounted on McGuire trucks, and each equipped with two W. P. 50 Thomson-Houston motors, fitted with the new series parallel controller. The track work is of the most substantial kind. It consists of 80-lb. Johnson girder rail, spiked direct to chestnut ties. Tie-rods have been placed every 7½ feet, while the fish plates are 26 inches, bolted with six 1-inch bolts. The track is well laid, and shows careful and conscientious work by the contractors. The line work has been put in by Messrs. J. G. White & Co., of New York, and is of the most substantial order. Side construction with heavy span wires has been used throughout. The poles are of the hollow-pipe pattern, being built up of 6-inch, 5-inch and 4-inch pipe. They were made by Morris, Tasker & Co., of Newcastle, Del., and seem to stand the strain wonderfully well. My only criticism on the line work is that the span wires are tied directly into eye bolts passing through the pole-top, leaving only the bell and the wooden plug as an insulation against grounds. All poles on the straight runs weigh 750 lbs., while the curves are of 1,000 lbs. weight.



Figs. 1 and 2.—New Power House of the Central Electric Railway Co., Baltimore.

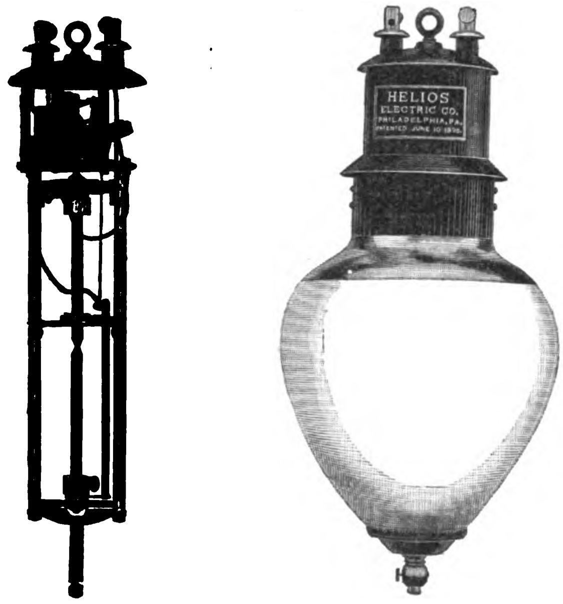
The consulting engineers of this road are Messrs. Blackwell and Murdoch, Mr. Blackwell having given his personal attention to the work, which is first class in every particular.

The Canadian General Electric Co.—Letters patent have been issued by the Dominion Government increasing the capital of this company from $1,000,000 to $2,000,000.

MISCELLANEOUS.

THE HELIOS ALTERNATING ARC LAMP.

NOTWITHSTANDING the large number of central stations that distribute alternating currents in the United States, it is a remarkable fact that but few arc lamps are now in operation, and this is the more strange, as the alternating current is especially adapted to long-distance lighting. For the past six years Mr. Carl Coerper, of Ehrenfeld, Cologne, Germany, has devoted his entire attention to the production of an alternating current arc lamp which should fill the requirements of a commercial lamp, and succeeded some two years ago in producing a lamp of which a large number are now in successful daily operation in Germany. The manufacture of this lamp has now been undertaken by the Helios Electric Company, of Philadelphia, which was organized specifically for this purpose, and the tests which we had occasion to witness leave little doubt that a large field will be open for the new product.


HELIOS
ELECTRIC CO.
PHILADELPHIA, PA.

FIGS. 1 AND 2.—HELIOS ALTERNATING ARC LAMP.

Our engraving, Fig. 1, shows the lamp mechanism exposed, and Fig. 2 the appearance of the lamp when burning. The construction and operation involve the most simple mechanism. As will be seen, the lower carbon holder is attached to a flexible cable which is carried over a pulley in the lamp mechanism, the other end being attached to the upper carbon holder. The result of this arrangement is that, as the lower carbon ascends the upper carbon descends, and in exactly the same ratio. The arc is thus fixed at a given point and remains stationary from the time the current is turned on until the carbons are consumed.

As is well known, the alternating arc forms a crater both in the upper and lower carbon, so that considerable light is emitted by the crater of the lower carbon, which is thrown upward, and thus generally wasted. To overcome this difficulty provision has been made in the Helios lamp by placing a white enameled reflector about 1½ inch above the arc, which throws down all the light emitted from the lower carbon, increasing the illuminating power 40 per cent., it is claimed.

The regulation is effected entirely by a single solenoid coil, the feed of the carbons being controlled by a lever which presses against the periphery of a friction wheel included in the releasing train. By this means a feed of $\frac{1}{1000}$ inch is made possible. The upper carbon holder is purposely made so as to slightly overbalance that of the lower carbon holder; the result is that the work of the solenoid coil and mechanism is restricted simply to the small weight representing the difference between the carbon holders. A free piston dash pot serves to steady the movement of the regulating mechanism.

The noise usually encountered in alternating current arc lamps has been entirely avoided, the lamp emitting no louder sound than the ordinary direct current arc lamp, and, we may add, burning with a steadiness which approaches closely to that of an incandescent lamp.

The design of the lamp, externally, is very artistic, the extreme length not exceeding 25½ inches.

These lamps are made of the following sizes: 300 watts, to produce 1,500 c. p.; 425 watts for 2,000 c. p They are connected in multiple arc and require only 28 volts, this having been found to be the most efficient pressure for alternating current. The Helios Company propose soon to supply a converter delivering 30 volts directly to the lamps.

ELECTRICITY AT THE DEDICATORY CEREMONIES IN CHICAGO.

A GLANCE at the electrical features displayed in Chicago during dedication week will not be without interest. Perhaps the most prominent was the great Schuckert search light built by Schuckert & Co., of Nuremberg, Germany, and which is installed upon the top of the Transportation Building at the World's Fair, and sheds its light over the city at night.

The current for running the search light was furnished by an Edison street railway generator, specially connected to furnish from 70 to 80 volts, and the current absorbed was about 150 amperes. This machine was employed for the purpose as the special one designed for use with the light was not ready.

It is to be regretted that there was not a night parade similar to the one in New York, so as to permit the liberal use of electrical floats and similar attractions. However, the electrical displays made by some of the large down-town stores and hotels were very creditable, especially so when it is considered that a large number of the electrical wiremen in the city were indulging in a strike, which was the reason that more electrical illuminations were not resorted to.

The display at the Auditorium Hotel, on Michigan avenue and Congress street was very handsome. From the tops of four tall pillars decorated with flags and buntings, strings of incandescent lamps were hung, and over the entrance were flags made of various colored lamps, to which a continual wave motion was given by a commutating arrangement, cutting the lights in and out. There was also a beautifully illuminated device comprising a cross, crown and initial letters. The current was furnished from the hotel isolated plant.

The "Leader," one of the large down-town dry-goods stores at the corner of State and Adams streets, made a pretty illumination. Incandescent lamps were freely used in the form of star-shaped shields and strings of hanging lamps.

Perhaps the most effective illumination was that made by Siegel, Cooper & Co,, the dry-goods merchants, who have one of the largest stores in the world on State street, between Van Buren and Congress streets. The arch over the entrance, surrounding the picture of the landing of Columbus, was beautifully outlined in incandescent lamps, and a large gilded eagle over the door was studded with lamps. On either sides were the dates 1492 and 1892 formed of lamps. The whole effect was strikingly beautiful. The *Inter-Ocean* had a very handsome electrical display on their building, corner Dearborn and Madison, of the stars and stripes and festoons of lamps; and the *Tribune* offices were also electrically illuminated.

A special temporary plant for lighting the Manufactures Building, in which the dedicatory ceremonies took place, was installed in the Machinery Hall. Eight arc dynamos, built by the Standard Electric Co., of Chicago, were run by Ball and Wood engines, steam being furnished from the regular battery of Babcock & Wilcox boilers, located there, and the current was furnished by these machines to arc lamps of Standard Co.'s manufacture, hung in groups of five in the Manufactures Building. In all, some five hundred additional arc lamps were used in lighting the buildings used during the ceremonies, and those in which the military were quartered and for illumination in the grounds. Those not supplied by current from the plant of Standard dynamos were operated from the regular temporary lighting installation in the grounds.

Displays of fireworks were held in Washington, Lincoln and Garfield Parks on the evening of Friday.

The whole pageant was one not to be easily forgotten by those who had the pleasure of witnessing it, and every one was surfeited with celebrations to their heart's content.

"THE ELECTRICAL ENGINEER" HOUSE WARMING.

A few months ago The Electrical Engineer moved into new quarters in the *Mail and Express* Building, Broadway and Fulton streets, New York City. These offices occupy the entire Fulton street wing and cover about 2,000 square feet. The building has been in a very backward state, and no electrical current was available until within the past week. Under these circumstances, the Engineer postponed its house warming until October 26, when in response to its invitation about 800 of its friends in this city came to pay their compliments and drink its health. Lunch was served by Cable in the reception room, from 12 to 3 p. m., and during that time all the various departments of electrical invention, commerce, manufacture, finance and study were represented by those who came to exchange greetings with the members of the editorial and business staff of the journal. The sentiments of friendship and esteem expressed towards The Electrical Engineer by so many well-wishers are the best return it could ask for its work in the past and the greatest incentive to effort in the future.

LETTERS TO THE EDITOR.

"NEITHER FISH, FLESH, FOWL, ETC."

In your review of "Recent Progress in Electric Railways," the matter for which I compiled for the publisher, your criticism is based largely on the fact that the compiled matter was limited almost entirely to that published in one journal. Permit me to say that such criticism is very unjust to the compiler in view of the fact that the preface distinctly states this limitation and makes no claims to include any but that one journal. It furthermore states that the compiler could not give the compiling the time he would have liked to give it. These statements ought to be sufficient to relieve the compiler from the blame which you direct to him in your criticism.

Owing to want of time and other circumstances beyond his control, the compiler was unfortunately not able to complete the compilation on the lines originally laid out and therefore had to limit himself to as much of the matter as was compiled at the time of publication, which part happened to be that from only one journal, the one with which the work was begun. But the fact that this fills a volume need not necessarily reflect discredit on the book, nor on the journal, nor on the compiler. Besides this, when an apology is made in the preface of a book for certain features which were unavoidable, it does not seem courteous to say the least, for a reviewer to disregard it completely.

Your unfavorable criticism to the effect that the book consists chiefly of quotations and abstracts, is on the face of it unjust, as that is the very thing that a compilation claims to be; it would have been unjust to the original authors not to have given them the credit for what was used of their matter.

The preface, moreover, is a publisher's preface and not an author's preface, which is evident from the omission of the compiler's name.

I might answer to a number of your other criticisms which I think are unjust, in which opinion I believe an unbiased mind would agree with me. Had all other journals but your own been used in the compilation you might have had reason for complaint, but the fact, as distinctly stated in the preface, that only one journal was used, an unfortunate limitation which was not premeditated, ought not to reflect on the compiler whose duties ceased with the compilation.

Carl Hering.

Philadelphia, Pa., Oct. 28, 1892.

[Mr. Hering's book says in so many words on its title page that it is a "summary of current periodical literature," and the preface uses the exact language we quoted from it. We said, and we repeat, that it is *not* a "summary of current periodical literature," but a bald "ad" for a single paper, whose name in it is thrust under one's eye at every possible and impossible opportunity. Our esteem for Mr. Hering as a clever journalistic colleague, as an able electrical engineer, as a writer of skill, and as a most amiable gentleman, makes us regret deeply that he could be seduced into such a performance as this wretched work, which is the queerest compound of fact, fiction and fol-de-rol that ever found its way into print as an electrical book. It is a great pity he did not keep his name off the title page as deliberately as he did off the preface, and so let the whole responsibility rest where it belongs.—Eds., E. E.]

THE COMPARATIVE EFFICIENCY OF THE COMMUTATED FIELD AND EXTERNAL RESISTANCE CONTROLLING RAILWAY SWITCHES.

Mr. Wellman's strictures on my articles entitled as above appear to be due to a misconception resulting from an oversight in his reading of it.

The second paragraph of my article begins thus: "For purposes of comparison we will assume that the resistance, turns in field, speed, current, etc., are the same in the two methods when all the external resistance is out of the circuit in the one and all the field coils are in parallel in the other." On this assumption all my arguments are based, and Mr. Wellman has not shown nor attempted to show that this assumption is unwarranted. Passing over the first paragraph of Mr. Wellman's article which merely contains the statement that I did not prove what I started out to prove, he passes on to give a résumé of my argument, and then says, "(The fact) that the resistance necessary to restore the speed (to a higher value) * * * * is less (in the commutated field method than with external resistance) is an argument in favor of external resistence; *i. e.*, we should use an intense field." That the field should be as intense as other considerations will allow is undoubtedly true, but Mr. Wellman has not shown, nor attempted to show, that the field will be any more intense in one method than in the other. And until he proves that the field can be made more intense with the external resistance than with the commutated field, it is not necessary to argue the point further. A little further down, the same statement is again made that the maximum field strength is obtained with external resistance.

Again, Mr. Wellman says: "This reasoning of Mr. Reid, also, only applies to decreasing the speed and how he would argue for on increasing speed, I dare not speculate on." By the assumption quoted above from my article, the two machines are exactly similar in every essential respect at their highest speed, and, therefore, since all the resistance is out of circuit in the one and all the field coils in parallel in the other, the speed cannot be increased by any change in either, and at full speed the efficiency of the two machines is the same by reason of the assumption I have made as a basis of comparison. Mr. Wellman's argument based on increase in speed would, therefore, assume the motors alike in every respect at some intermediate position of the switch, which is directly contrary to the basic assumption of my article. The last paragraph gives an indication of what Mr. Wellman took as a basis of comparison, since he says there that the current can never be the same in the two methods except at the first position of the switch, that is, when all the resistance is in circuit in the one and all the field coils in series in the other. If this statement, which is unsupported by argument, is true, then my argument falls to the ground and Mr. Wellman's arguments are good. In other words, the whole question between Mr. Wellman and myself rests on the propriety or impropriety of my fundamental assumption. Admitting that assumption, my argument, and therefore my conclusion, follows naturally. I will repeat what I said in concluding my article, that I did not attempt to decide which was the *best* method, but which was the most economical in the use of power.

Thorburn Reid.

Lynn, Mass.

THE OPERATION OF UNIPOLAR DYNAMOS.

In your issue of the 19th inst., Mr. W. E. Hyer rather severely criticises the quotations given by me from Prof. Silvanus Thompson's "Dynamo-Electric Machinery," and thinks it "unfair" to Prof. Thompson to quote his words in respect to one class of dynamos in condemning a modification of another distinct class."

The quotation to which Mr. Hyer so much objected was the following: "If the *coil* be moved by a motion of translation to another part of the uniform field, as many lines of force will be left behind as are gained in advancing from its first to its second position and there will be no current generated in the coil."

Let me say right here, that the quotation, as given, was not intended as an exhaustive explanation, but simply as a hint where such might be found. But as it seems that Mr. Hyer entirely misunderstood this quotation, it appears necessary to say what it really does mean, and at the same time place Prof. Thompson and myself in the right light in his estimation.

If a coil, with its plane normal to the lines of force, be moved across a magnetic field of uniform strength, electromotive forces will be produced in both sides of the ring, but both being of the same sign, they will evidently balance each other and no current will be generated. If the field is not uniform, then one part of the coil will cut more lines of force than the other, there will be a difference of potential between the two sides of the coil and a current will be generated.

It is not necessary to go into the different variations of this rule, and though Mr. Hyer considers it as "the A B C of the practical dynamo construction," I have found from personal experience, that most of the failures in the invention of unipolar dynamos have been caused by inattention to this rule, and in one case this happened to one of the leading electricians of this country.

There is not, as Mr. Hyer seems to think, a different law for different kinds of dynamo; the one cited holds good, no matter if the conductor is part of a unipolar, bipolar or multipolar dynamo. Neither is it the case with the ordinary bipolar and multipolar dynamo, that "the current is produced in the conductor by altering the number of lines of force that flow through it." On the contrary this non-uniformity in the number of lines of force cut, and the changing from one polarity to another is just the evils that inventors have attempted to avoid in the unipolar dynamo.

Mr. Balch in his article does not explain enough of the details of his apparatus; it is therefore difficult to point out just where the fault lies. The following lines from his article seemed to me, at the time, to indicate where the trouble might be, viz.: "If a soft iron tube is employed, a coil of wire, not shown, will have to be slipped over it to excite magnetism." If the tube is of some length, and the coil is placed near one end of it, the lines of force would not run through the air to the other end of the tube, but would return to the same close behind the coil. The conductor would therefore be cut by lines of force coming from opposite directions and there would be no current. Perhaps this might be somewhat obviated by an exterior shield for the return circuit. It is also a question if the coil would not have to revolve also, in order to make the conductor cut lines of force.

D. C. Reusch.

New York, Oct. 24, 1892.

SPARK LENGTH.

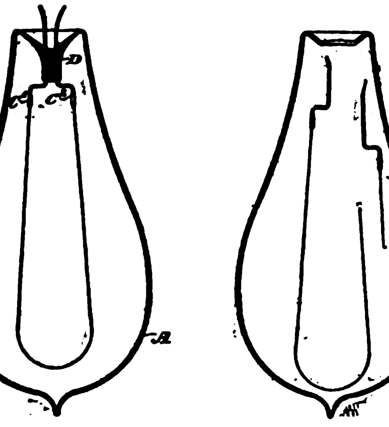
Two plane circular metallic discs are kept parallel to each other. One of the discs is fixed and absolutely insulated; the other, movable, and connected with the earth. If the movable disc is brought to within .08 of an inch of the fixed disc, a spark passes between them in air. What is the potential of the fixed disc just before the discharge?

Querist.

New York City, Oct. 27, 1892.

THE SMITH SEPARABLE INCANDESCENT LAMP.

Much attention has recently been devoted by inventors to the devising of incandescent lamps so constructed that the filament when burnt out can be renewed, thus permitting of the further utilization of the other parts of the lamp. The most recent device of this kind is that just patented by Mr. Frank S. Smith, superintendent of the lamp department in the works of the Westinghouse Company in Pittsburgh. He has found that certain compounds of the alkaline with the silicon group of elements may be used to form a portion of the lamp, more particularly the supporting stem which carries the leading-in wires. These compounds are soluble in hot water and have certain physical characteristics which permit them to unite with the wires under the influence of heat, making air-tight joints, and they also unite with the glass portion of the chamber. In this way there is formed a composite inclosing chamber, a portion of which is of glass, while the remainder is of a soluble material.



Smith Separable Incandescent Lamp.

The accompanying engraving, Fig. 1, shows the lamp complate, the leading-in wires C^1 C^2 being carried by the soluble compound *D* which is fused to the glass globe A. Mr. Smith finds that the selection of the best compound depends largely upon the composition of the glass portion of the globe. The greater the proportion of the alkali with reference to the silica the softer will be the resulting compound. The compound, $4Na_2O.5SiO_2$, makes a perfect union with platinum leading-in wires and will also unite with a glass having a sufficiently low fusing point.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the monthly meeting of council, held at 12 West 31st street, New York City, October 25th, the following associate members were elected:

Arnold, Bion J., consulting engineer, General Electric Company, 4128 Prairie avenue, Chicago, Ill.
Jeffery, D. Herbert, secretary and treasurer, Crocker-Wheeler Electric Company, 430 West 14th street, New York City.
Meyer, Julius, consulting engineer, North American Company, Mills Building, New York City.
Pearson, F. S., chief engineer, West End Street Railway Company, 439 Albany street, Boston, Mass.
Spencer, George Jarvis, electrician, the Yale & Towne Mfg. Company, Stamford, Conn.
Tapley, Walter H., electrician in Government Printing Office, care Public Printer, Washington, D. C.
Van Buren, Gurdon C., electrician, 5 Wilson street, Albany, N. Y.
Wallace, Geo. S., telegraph office manager, Chesapeake and Ohio Railway Company, Box 214, Clifton Forge, Va.
Weaver, Norman R., superintendent of repair department, General Electric Company, 173-5 Adams street, Chicago, Ill.

The following associate members were transferred to full membership:

Pike, Clayton W., Jas. W. Queen & Co., Philadelphia, Pa.
Bishop, Jas. D., electrical expert, J. A. Roeblings' Sons Co., 345 West 34th street, New York City.
Barberie, E. T., electrician, Safety Insulated Wire Co., 234 West 29th street, New York City.
Heinrich, Richard O., electrical engineer, Weston Electrical Instrument Co., Newark, N. J.
Rae, Frank B., electrical engineer, 27 Cleland Building, Detroit, Mich.

At the meeting of the institute in the evening, the three electric railway papers read at the general meeting in Chicago last June were discussed. The titles of the papers are as follows: "Series Electric Traction" by Mr. Nelson W. Perry; "A New System of Electric Propulsion" by Mr. H. Ward Leonard; "Electric Railway and Motor Tests" by Prof. Geo. D. Shepardson and Mr. E. P. Burch. The discussion was opened by Dr. Cary T. Hutchinson, and continued by Messrs. Sprague, Mailloux, Emery, Crocker and Henshaw.

The report of the Committee on Units and Standards was accepted and referred to the sub-committee on Provisional Program for the International Electrical Congress of 1893.

NORTHWESTERN ELECTRIC LIGHT ASSOCIATION.

A meeting of the Northwestern Electric Light Association was held at Oconto, Wis., last month, delegates being in attendance from Northern Wisconsin and Michigan. The object of the meeting was to exchange ideas and the advancement of the electric light business. H. C. Higgins, of Marinette, was elected president; Q. A. Pamperin, of Oconto, secretary. Carl Collins represented Green Bay; A. A. Page, Oshkosh; George A. Davis, Neenah; K. L. Lust, Antigo; C. S. Deball, Sheboygan. Many others were present. A banquet was given at the Beyer House in the evening by Q. A. Pamperin.

THE TELEPHONE WIRES IN CINCINNATI.

The telephone wires of Cincinnati, O., are to be taken from the streets, and made to radiate from poles placed in the centre of blocks connecting with the underground system at the foot of the poles. In this way no wire will cross a street. The distributing poles will be provided with a platform near the top supporting an iron ring, equipped with 104 insulators. A cable will be led from the main subway, by a smaller conduit, to the foot of the pole and then up the pole to a point opposite the distributing ring. The terminal head holding the feed wires is covered by a galvanized iron hood, raised by a pulley above it. From under this hood 100 wires will pass, gathered into five cables, to the edge of the bottom floor and then up to the distributing ring. These poles are the device of Mr. W. H. Robinson, superintendent of construction of the telephone company.

HARVARD UNIVERSITY.

The Electrical Department of the Scientific School has been fitted with a Thomson-Houston 500-volt motor and a complete set of shop machinery, including two machine lathes, two speed lathes, a drill press, and milling machinery.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED OCTOBER 18, 1892.

Alarms and Signals :—

Electric Fire Alarm, J. J. D'Almeida and J. Y. de Silva, Lisbon, Portugal, 484,886. Filed May 2, 1890.

A thermostatic fire alarm.

Fusible Fire Alarm, G. B. Smith, St. Cloud, Minn., 484,469. Filed May 10, 1892.

A thermostat employing a non-metallic fusible insulating material and two springs pressing against this insulation and normally kept out of contact thereby.

Combination Lock and Alarm, R. Baumann, St. Louis, Mo., 484,577. Filed Aug. 20, 1891.

A sliding drawer containing a battery and bell and electrical connections for automatically closing the signal when the drawer is tampered with.

Electrical Railway Signal, B. C. Seaton, Nashville, Tenn., 484,614. Filed March 1, 1892.

An electric alarm signal for steam railways.

Draught Indicator for Vessels, W. R. Patterson, Manistee, Mich., 484,642. Filed July 18, 1892.

Employs a standpipe in the hold of the vessel communicating with the water outside, a float within the pipe and an electric signal which operates when the float reaches a certain predetermined position.

Burglar Alarm, A. Stromberg, Chicago, Ill., 484,761. Filed July 19, 1892.

A flexible covering adapted to be placed at doors, windows, etc., and to sound an alarm if disturbed.

Electric Bell, J. E. Thron, Philadelphia, Pa., 484,762. Filed June 18, 1892.

The invention consists in combining the armature of the electromagnets with a secondary lever carrying the hammer upon a flexible arm, spring actuated in one direction and drawn away in the other direction by means of a trip-pawl controlled by the moving armature.

Distribution :—

System of Electrical Distribution, D. B. Brace, Lincoln, Neb., 484,549. Filed Sept. 16, 1891.

Provides means for simultaneously transmitting periodic and continuous currents.

Dynamos and Motors :—

Regulator for Dynamo Electric Machines, C. E. Scribner, Chicago, Ill., 484,611. Filed May 5, 1890.

Relates to that class of regulators in which the connecting brushes are automatically shifted to increase and decrease the electromotive force.

Electric Motor Dynamo, A. W. Smith, San Francisco, Cal., 484,724. Filed Jan. 25, 1892.

Employs a ring armature with a Gramme winding and two field magnets having their unlike poles in close proximity placed at diametrically opposite points of the armature.

Frame for Electric Dynamos, J. B. Fralley, San Francisco, Cal. Design 21,906. Filed Aug. 16, 1892.

Heating:

Electrically Heated Hand-Stamp, J. B. Venker, St. Louis, Mo., 484,574. Filed Dec. 11, 1891.

The combination with a base plate and contact plate, of electrical resistance located at the back of the contact plate and insulated from the base plate, and inwardly projecting pins between the plates to retain them in their proper relative position.

Lamps and Appurtenances :

Lantern for Electric Lighting, D. S. Page, Malden, Mass., and J. L. Bertsch, Cambridge, Mass., 484,449. Filed Dec. 12, 1891.

Electric Light Fixture, D. S. Page, Malden, Mass., 484,450. Filed Dec. 12, 1891.

The invention consists of a water-tight chamber enclosing the incandescent lamp and separated from the woodwork to which it is attached by an air space.

Electric Lighting System, B. B. Ward, New York, 484,479. Filed Mar. 1, 1892.

Claim 2 follows:

The combination with electric arc lamps run in series on constant potential mains and each having a main and a derived circuit magnet with a movable, core, of a mass of iron opposite the ends of the cores for both magnets in each lamp of the series.

Hanger-Board for Electric Arc Lamps, B. B. Ward, New York, 484,480. Filed April 30, 1892.

Electric Arc Lamp, C. Coerper, Coeln, Germany, 484,530. Filed June 18, 1892.

Has for its object to provide a simple feeding mechanism for the carbons, and a reflector which will not become blackened with use.

Electrode and Incandescent Electrical Conductors, L. L. Jones, Brooklyn, N. Y., 484,553. Filed Sept. 16, 1885.

Process consists in mixing a solution containing a non-conducting earth and a metal, then drying the mixture, converting into oxides, and forming into an electrode.

Mast-Arm for Electric Light Poles, A. B. Allison and G. B. Scott, Pittsburgh, Pa., 484.565. Filed March 21, 1892.

Lamp Socket and Circuit Closer Therefor, S. Bergmann. New York, 484,580. Filed May 18, 1892.

Employs an insulating body in the socket having at one end two springs, one connected with the central contact of the socket and the other being a switch spring.

Metal Working :—

Apparatus for Refining Metals by Electricity, C. R. Fletcher, Boston, Mass. 484,416. Filed Nov. 25, 1891.

Apparatus for Annealing Wire or Metallic Rods by Electricity, J. H. Hunter, Pittsburgh, Pa., 584,637. Filed June 2, 1891.

Apparatus for the Manufacture of Metallic Articles by Electrolysis, A. S. Elmore, Leeds, England, 484,704. Filed July 23, 1891.

Miscellaneous:—

Lightning Arrester, E. Searing, Denver, Col., 484,466. Filed Jan. 20, 1892.

Employs a pair of electrodes enclosed in a tube containing a non-striking vacuum.

Insulating Joint, C. Wirt, Chicago, Ill., 484,483. Filed Aug. 29, 1891.

Electrode for Medical Purposes, E. H. McBride. Springfield, Mo., 484,522., Filed July 21, 1692.

An electrode having a non-conducting casing for cataphoric medication.

Drawing and Stippling Pen, J Phillips, London, England, 484,523. Filed May 1, 1892.

Electrical Curling Iron, A. D. Gardner, Lynn, Mass,. 484,532. Filed Oct. 21, 1891.

Apparatus for Electroplating, F. B. Howard, Irvington, N. J., 484,535. Filed Aug. 13, 1890.

Electrical Inductorium, L. S. M. Pike and H. T. Barnett, London, Eng., 3. Filed Feb. 5, 1892.

Employs a dehydrated liquid hydrocarbon surrounding the inductorium and means for maintaining a continuous flow of liquid.

Electrical Inductorium, L. S. M. Pike and E. S. Harris, London, Eng., 484,544. Filed Feb. 5, 1892.

Employs U-shaped plates interleaved with porous insulating material and applied alternately to opposite ends of the coil and bolted together in groups.

Process of Duplicating Phonograms, T. E. Edison, Llewellyn Park, N. J., 484,582. Filed Mar. 30, 1892.

Phonograph Cutting-Tool, T. A. Edison, Llewellyn Park, N. J., 484,583. Filed Mar. 27, 1890.

Phonograph-Reproducer, T. A. Edison, Llewellyn Park, N. J., 484,584. Filed Mar. 27, 1892.

Phonograph, T. A. Edison, Llewellyn Park, N. J., 484.585. [Filed Mar. 30, 1890.

Electric Appliance for Canes, S. D. Smith, Milwaukee, Wis., 484,618. Filed Dec. 7, 1891.

A walking stick containing a source of electric energy and a switch for making and breaking the circuit.

Railways and Appliances :—

Skylight for Electric Cars, H. Cochran, Chester, Pa., 484,515. Filed Mar. 23, 1892.

Switches and Cut-Outs :—

Electric Fuse Box, W. Stanley, Jr., and J. H. Kelman, Pittsfield, Mass, 484,545. Filed Dec. 21, 1891

Telephones and Apparatus :—

Multiple Switchboard System, C. E. Scribner, Chicago, Ill., 484,612. Filed Jan. 21, 1892.

The invention consists in winding each individual annunciator differentially and connecting the branch of the line connected with the springs of the switches through one of the differential windings and the branch which connects the test pieces to the other of the differential windings.

Substation Apparatus for Telephone Systems, C. E. Scribner, Chicago, Ill., 484,613. Filed Jan. 21, 1892.

Employs a signal receiving apparatus and a telephone at the substation, both being in permanently closed and independent parallel branches between the sides of the line.

Telephone Exchange Apparatus, J. J. Carty, New York, N. Y., 484,626. Filed Nov. 29. 1889.

Claim 1 follows:

A coil of a telephone apparatus connected between the strands of a flexible cord and a branch connection to ground at the centre of said coil in combination with a metallic circuit, including the strands of said cord in different sides thereof.

REPORTS OF COMPANIES.

THE WESTERN UNION TELEGRAPH CO.

At the annual meeting of stockholders of the Western Union Telegraph Co., the two vacancies in the board of directors, caused by the death of Messrs. Cyrus W. Field and Sidney Dillon, were filled by the election of Messrs. Henry B. Hyde and G. Murray Crane. From the report of the treasurer, it appears that there has been an increase of gross revenues over those of last year of $672,078 and a reduction of gross expenses of $120,884. The average rate of tolls has been reduced .9 cent, and the average cost of service, a similar amount. During the year 1,595 miles of poles have been planted, 23,512 miles of new wire strung and 602 new offices opened. The capital of the Western Union has now been made $100,000,000

PERSONAL.

Mr. Max Luhn, engineer of the Helios Co., Cologne-Ehrenfeld (Germany), who, after a journey of information in this country, on the 26th of October, returned to Europe on the "City of Paris," was not only very much pleased with what he has seen in the electrical field in America, but also with the kind reception he has received everywhere. He begs us to thank, in his name, the different companies, and the engineers whom he has met, for their kindness, and he invites them (if they should come to Germany) to visit him and the factories of the Helios Co.

LEGAL NOTES.

EDISON ELECTRIC LIGHT COMPANY AND EDISON GENERAL ELECTRIC CO. vs. SAWYER-MAN ELECTRIC CO.

One of the consequences of the recent decision of the U. S. Appellate Court in the Edison lamp case, is the revival of the old suit of T. A. Edison and the Edison Lamp Co. *vs.* Sawyer-Man Electric Co. The old suit is discontinued and a new one instituted by the Edison Electric Light Co. and Edison General Electric Co., the latter being successor to the rights of Mr. Edison and the Edison Lamp Co. Basing their action upon the recent decision of the Appellate Court the complainants have served notice of a motion for a preliminary injunction, to be heard Friday, November 4, in the United States Circuit Court, Southern District of New York.

COSTS IN THE EDISON LAMP CASE SETTLED.

An agreement between counsel for the Edison and United States Electric Lighting Companies, relative to costs in the incandescent lamp case recently decided by the Circuit Court of Appeals has been reached, and the sum agreed upon, $781.50, has been paid into the treasury of the General Electric Company.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

The firms that advertise are the largest employers of labor.

CARHART-CLARK STANDARD CELLS.

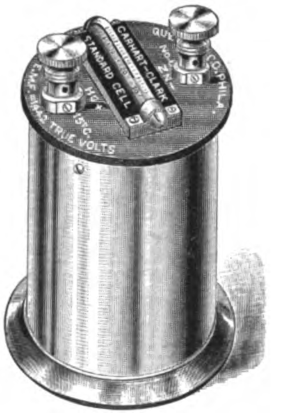
THE accompanying illustration shows a new form of the Carhart-Clark cell with thermometer permanently attached. This type is well and favorably known to scientists both here and abroad, but for the benefit of those who may not remember all of its special features we give the following brief description:

The Carhart-Clark standard cell is the result of several years' study devoted to the subject of standard cells by H. S. Carhart, professor of physics and electrical engineering, at the University of Michigan. Recognizing the fact that all known forms of standard cells had but small endurance, and could not, in the least, stand the jars and strains of transportation without permanently destroying both accuracy and constancy, Prof. Carhart about five years ago started out on a basis of Lord Rayleigh's experiments in standard cells, with a view to making a cell having no local action, perfectly sealed, giving a uniform and constant E. M. F. for all time, and which should not be injured by transportation.

After over two years' study and trial Prof. Carhart, in the early part of 1889, completely solved the problem. The Clark cell, as is well known, is composed of zinc and mercury as electrodes, and mercurous sulphate and zinc sulphate as salts. Great difficulty has always been found in securing the ingredients as a pure state, the smallest amount of foreign matter being sufficient to destroy the reliability of the cell. Another great trouble has been that in transportation, the mercury would be so shaken through the other salts as often to cause a short-circuit. The first of these difficulties Prof. Carhart has overcome by making his own chemicals, the second by the use of a special device, so that any short-circuit in transportation is practically impossible.

One of the chief points of the Carhart-Clark cell is its very low temperature coefficient. By a method discovered only after long and laborious investigation, the temperature coefficient has been reduced from 0.08 per cent. per degree C. to about .0.03, or from 0.00077 to 0.00039, thus making for all practical purposes the temperature change inappreciable. Each cell has, inside of its mounting, an extra graphite resistance of about 10,000 ohms, so that no particular injury will result, should it be accidentally short-circuited for a short time.

The cells proper are prepared by Prof. Carhart at his laboratory in the University of Michigan, and are furnished with his personal certificate of accuracy which also states the exact E. M. F., at 15 degrees C. and the temperature co-efficient of the cell. Queen & Co., Philadelphia, who prepare the mountings for the above have issued a descriptive pamphlet No. 325 which, along with other information regarding the cells contains reports of some exhaustive and very flattering tests. A copy can be obtained from them for the asking.



CARHART-CLARK STANDARD CELL.

BALL ENGINE CO. OF ERIE, PA.

THE BALL ENGINE COMPANY, of Erie, Pa., report that they are having the largest amount of business in their existence, and have enough orders to carry them well through the winter. Among some of their recent orders are the following:

Brockton Street Railway Co., Brockton, Mass., one 600 h. p. cross-compound; Calumet Street Railway Co., Chicago, Ill., four 300 h. p. cross-compound; San Leandro Street Railway Co., San Francisco, Cal., one 500 h. p. tandem compound; East Oakland Street Railway Co., San Francisco, Cal., one 400 h. p. tandem compound; Englewood Electric Light Co., Chicago, Ill., one 600 h. p. cross-compound; Binghampton Electric Light Co., Binghampton, N. Y., two 250 h. p. tandem compound; Wheeling Street Railway Co., Wheeling, W. Va., three 250 h. p. cross-compound; Pottstown Electric Light Co., Pottstown, Pa., one 250 h. p. cross-compound; Erie Electric Motor Co., Erie, Pa., three 150 tandem compound.

THE GERMANIA UNIVERSAL TIN SHADE.

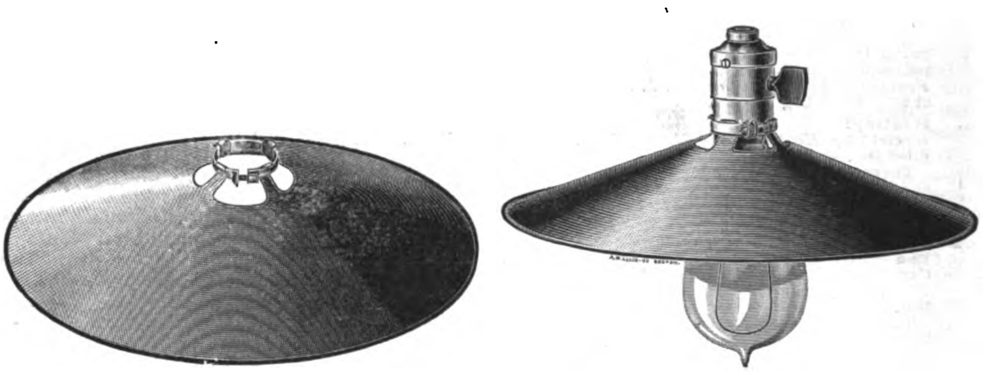
To the trade, which is already familiar with the Germania Universal shade holder, the convenience of the tin shade recently devised by the Germania Electric Co. of 620 Atlantic avenue, Boston, here described, will be at once apparent, it being essentially that shade holder stamped directly from the material of the shade itself, and applicable to any socket without any difficulty of adjustment of screws or any centering whatever.

The holder attachment consists of four little lugs or fingers stamped from the centre of the shade; the ends of these lugs are then turned upward for about a quarter of an inch, and outward again just sufficiently to form a catch for the clamping ring, which is adjustable to the size of any of the sockets on the market by means of the screw which fastens it together.

To apply this shade to any of the regular sockets, the ring is removed and the lugs sprung around the outside of the socket shell and allowed to rest upon the fillet at the edge of the shell. The ring is then placed around the outside of the lugs and the screw tightened so that the shade is clamped firmly in place. When it is desired to attach this shade to the regular Edison socket, the ring is dispensed with entirely, and after removing the rubber bushing from the socket, the lugs are pushed inside the shell where the little projections catch in the fillet of the socket shell, allowing the bushing to be screwed into position again, which in entering the shell holds the shade securely.

This construction is a great advance, as the holes around the socket allow a circulation of air tending to cool the lamp,—a material factor in lengthening the life of the filament.

It is not intended to sell these shades in any finish other than with a fine enamel which gives a smooth white surface wearing for years, and which can be readily washed and kept clean; a material much preferable to lead paint in retaining its color and not becoming yellow by age. On the outside the finish is a fine glossy green japan. The saving in expense of both the shade holder and labor in attaching the shade to the shade holder, also recommends this handsome piece of apparatus.



THE GERMANIA UNIVERSAL TIN SHADE.

PHOTOGRAPHIC PAPER FOR COPYING TRACINGS.

A PHOTOGRAPHIC paper for copying tracings, which gives black lines on a white ground, is being put on the market by Schwenke, Kirk & Co., of 26 Church street, this city. Not only has this paper the obvious advantage over ordinary blue prints of giving more suitable colors for the ground and lines, but after exposure in the printing frame the only treatment required for developing and fixing is a plain water bath. A paper of this sort has long been desired by engineers, and many inventors and chemists have searched for years for some compound which could be used in the preparation of such a paper. The compound appears to be an organic substance, which can be bleached by the sun, but is precipitated as a dark purple powder when it and its suspending medium are brought into water. This powder forms a black deposit in the paper and is quite permanent. The price of the paper is not any higher than the best blue-print paper, and it entails no expenditure for developing chemicals.

Mr. A. L. Rohrer.—A magnificent farewell dinner was given Mr. Rohrer on the occasion of his leaving the Lynn factory of the General Electric Co., for the factory at Schenectady. When he went to the Lynn factory eight years ago they employed 100 men. The number to-day is about 3,000. The dinner was given at the Hotel Thorndike, Boston, and Prof. Elihu Thomson was present.

NEW YORK NOTES.

The C. & C. Electric Motor Co. reports the following recent sales made by this company through its New York, Chicago and Boston offices: Menominee Electrical and Mechanical Co., Menominee, Mich., a 15 h. p. and a 3½ h. p. motor, and 6, 4 and 3 K. W. dynamos; Baydenoquet Co., Nahma, Mich., a 12 K. W. dynamo; Armour Packing Co., a 25 h. p. motor and two 5 h. p. motors; De La Vergne Refrigerating Machine Co., this city, a 15 h. p. motor. They have orders filled and unfilled from a single crane company for over 50 machines, consisting of one 20 h. p. motor, nineteen 16 h. p. motors, thirteen 12 h. p. motors, nine 8 h. p. motors, the balance being in sizes below 8 h. p. Laclede Power Co., St. Louis, Mo., three 25 h. p. and two 10 h. p. motors; Heidt & Son, Jersey City, N. J., a 20 h. p. motor; H. R. Worthington, Brooklyn, N. Y., 10 and 3 h. p. motor; Harvey Street Car Works, Harvey, Ill., a 30 K. W. plant, including lights and installation; Midvale Steel Co., Nicetown, Philadelphia, Pa., 80 K. W. dynamo and Ball engine, including installation; Boston and Maine Elevator (Messrs. Simpson & Robinson) Charlestown, Mass., 20 K. W. dynamo, lamps and installation; Home for Paupers, Long Island, Boston Harbor, three 13 K W. dynamos, three 5 h. p. and two 2 h. p. motors.

Ball & Wood Co.—Among the engine concerns which will be most prominently represented at the coming Exposition in Chicago, will be the Ball & Wood Company, of No. 15 Cortlandt street, New York, which has arranged with the Brush Electric Company to furnish the Exposition authorities a complete lighting plant. This will contist of five Ball & Wood engines comprising two simple engines, 150 h. p. each, two tandem compound engines, 150 h. p. each, and one cross-compound engine of 200 h. p. These engines will operate 16 Brush dynamos, and three of them have already been delivered and were in use during the recent inaugural ceremonies. These compound engines have been fitted with the new valve covered by Mr. Ball's recent patents, which makes these engines distinctive not only in appearance but in economy. The Ball & Wood Company is now executing contracts at Bethlehem, Scranton, Columbia, Pittsburgh, as well as in a number of other prominent Eastern cities.

WESTERN NOTES.

The Wirt Voltmeter.—Probaby no element of so much real importance is so little appreciated as a good pressure indicator. This will apply to isolated plants more than to central stations, but there is still ample room for improvement with the latter. It is a fact that there are many stations operating large numbers of incandescent lamps that either have no indicator or have one that is of no practical value. One would as much expect to operate a 100 h. p. boiler without a steam guage, as to run even a 50-light dynamo without a volt indicator. Many complaints of short-lived or inefficients lamps can be traced to the absence of an indicator. The Wirt volt indicator made by the Electrical Supply Company, corner of Michigan avenue and Randolph street, seems to be one of peculiarly sensitive adjustment and excellent workmanship, and the manufacturers are in daily receipt of letters expressing the greatest satisfaction with their use.

The Southwark Foundry & Machine Co., of Philadelphia, represented by Mr. Frank W. Bunn, 353 Rookery, Chicago, have just secured the contract from the Chicago Edison Co., for six of their vertical triple-expansion condensing Porter-Allen engines, aggregating 4,240 h. p. rated capacity, for their new station at Harrison street on the river front. Each engine will carry two multipolar Edison generators coupled direct, one on each end of the shaft. Work on these engines will be commenced immediately. The work on the building has been going on for some time. The Southwark Foundry & Machine Co. have almost completed two large vertical 1,200 h. p. engines, one of which we understand is for the Cincinnati Edison Co. of Cincinnati.

Taylor, Goodhue & Ames are pleased with the success which has already attended their efforts, although they have been in the field less than a month. They have secured several nice arc lamp orders, and are also pushing the well-known Burton electric car heater. The demand for specialties made by the Wagner Electric Mfg. Co. and the Columbia Incandescent Lamp Co., for which they are agents, is brisk. Orders for the Philadelphia trolley, which made so favorable an impression upon practical men at the recent Cleveland convention, are beginning to come in. Taylor, Goodhue & Ames report business in all their line of specialties as excellent.

The Mosher Electric Co., 125-127 Ontario street, Chicago, of which Mr. G. L. Reimann is president, John A. Mosher, the patentee of the lamps, vice-president, and Mr. John A. Sherriff, secretary and treasurer, report a prosperous and increasing trade in Mosher arc lamps for all direct and alternating constant potential circuits. Since Sept. 1, when the present officers took charge of the business, more than 250 of these favorite lamps have been shipped and they are unable to keep pace with their orders. They are, however, rapidly increasing their facilities to give them a capacity to turn out 500 lamps per month. They are receiving some very flattering testimonials regarding the burning of these lamps and have some specially fine ones concerning the operation of their series lamps burning ten in series on constant potential circuits.

The Siemens-Halske Electric Co. of America have now sufficient large contracts on hand to keep their factory busy for three months at least. Their apparatus is being received with general favor throughout the country, and everything points to their securing a large share of the electrical business of the country which is every day increasing. Work on their factory is being pushed along rapidly, and when completed it is expected to be one of the most complete and best equipped in the United States.

The Sunbeam Lamp.—The meritorious features of the Sunbeam lamp are beginning to be publicly appreciated everywhere, and the Sunbeam Incandescent Lamp Co., Chamber of Commerce Building, Chicago, are pushed to the utmost capacity of their factory to fill their many orders. They are now running up till ten o'clock every night and taking on new help as fast as it can be secured. This large trade they consider to be entirely due to the general satisfaction given by their lamps.

Mr. Frank McMaster, traveling representative for George Cutter, electrical specialties, 829 Rookery, is back in the city for a few days. He expects to leave shortly on an extended Western trip. He reports business as good and that the choice line of specialties which he carries, many of which are invented and manufactured solely by Mr. Geo. Cutter, are being received very favorably in all parts of the country he visits.

The Electric Appliance Co. have just patented, and are placing on the market, a new expanding wire guard to be known as the "Acme." It is a decided improvement on anything heretofore attempted in this line, both in appearance and adaptability, and promises to find a ready sale. In fact, the Electric Appliance Company have already booked large orders from a number of jobbers in different parts of the country.

Col. J. H. Shay of the Charles Munson Belting Co., Chicago, had to return from the Cleveland Street Railway Convention owing to sickness. He has been suffering for a couple of weeks from an attack of rheumatism but is now much better and able to be about. The Colonel reports the belting business as excellent and the trade with electrical companies is increasing all the time.

Mr. W. L. S. Love, vice-president of the Pond Engineering Co., has been for some time in Chicago taking charge of the company's office here, and states that it is his intention to make Chicago his permanent home and headquarters. Mr. Love reports some large contracts on hand for complete steam power plants and business as first-class generally with a very encouraging outlook.

The American Battery Co., 177 La Salle street, Chicago, manufacturers of storage and dry batteries, are in receipt of numerous orders for their Planté type of cells, for the advantages of which they make many strong claims. Among other points in which it is stated they excel, is their immense durability and the capability of withstanding the heaviest discharge without injury.

The Illinois Electric Lamp Co.—The lamps manufactured by the Illinois Electric Lamp Co. are in great demand. Mr. Bennett, manager of the company, says that they have all they can do to keep pace with their orders, but they are rapidly increasing their output, and that the quality of the same receives the due appreciation of their customers.

Mr. J. H. Cooke, manager of the Chicago office of the Buckeye Electric Co., 427 Rookery, is furnishing a great many of their lamps to users in all parts of the country. Mr. Cooke is one of the old dealers in the lamp business and knows just how to push a good article.

Clark & Marshall, the Rookery, Chicago, are doing a good business with the Boston incandescent lamp and the other line of specialties which they are handling. They expect to add several new and valuable devices to their line within the very near fature.

Mr. Alfred E. Kornfeld, New York representative of *The Electrical Age* and *Street Railway News*, was among the recent visitors to Chicago. Mr. Kornfeld is looking well and enjoying his visit to the Western metropolis.

The Post-Boynton-Strong Co. are receiving a great many orders for their crowfoot battery zincs. These goods are guaranteed to be made only from virgin spelter, assaying 99.354 per cent.

The Valentine-Clark Co., No. 540 Rookery Building, Chicago, are meeting with a large sale of their poles and ties for street railway purposes. The demand also for poles for electric lighting is very brisk. Their business during the past season has been exceptionally good, and during this fall they are expecting a largely increased demand and are busily preparing themselves to meet it. They intend carrying a greatly increased stock on hand at all times and are establishing more yards at various initial points, enabling them to handle orders from any section of the country with despatch. They are representing the Walworth Manufacturing Co. throughout the Western territory on their famous tubular steel poles and have booked a number of good orders for them already this season.

The Mosher Arc Lamp and Manufacturing Co., of 127 Ontario street, Chicago, have recently largely increased their facilities for turning out their lamps, which are becoming great favorities for incandescent and power and street railway circuits. Their orders are continually on the increase, and reports from customers indicate that they are greatly pleased with the lamps. They are placing on the market also, an entirely new form of arc lamp for alternating current circuits for which some very remarkable results are claimed.

Mr. Walter A. Crowdus has now perfected a special dental outfit operated by his well-known primary batteries which he has recently greatly simplified and increased in efficiency. He has also brought out a complete sewing machine outfit which promises to come into widespread use. For his work he has designed a special form of small motor which gives excellent results, absorbing very little energy. All these goods are manufactured by the Union Electric Works, Springer Building, Chicago.

Mr. Thos. G. Grier, Western manager of the Bryant Electric Co., who has offices at 1522 Monadnock Building, is very busy and the demand for their specialties is steady. Mr. Grier, L. K. Comstock and E. E. Shaw are delivering a series of lectures on physics and electrical engineering at the Hull House, No. 335 South Halsted on special evenings from 7.30 to 9.30. We are glad to see some of the electrical fraternity turning their attention from business to philanthropic objects such as this is.

The Q. & C. Co., 703–707 Phœnix Building, successors to Dunham Manufacturing Co. are doing an extensive business in their railway specialties. Among other goods which they control are the Dunham car door, the Q. & C. trolley, Davis spike, Consolidated brake adjuster, and Globe ventilator. They have also recently sold a great many of the Bryant metal sawing machines which they manufacture in several styles for both mechanical and hand power.

The Indiana Rubber and Insulated Wire Co., whose office is No. 242 Madison street, Chicago, are pushing the capacity of their factory at Jonesboro, Ind., with numerous, large orders they are receiving for Paranite wires and cables. The rubber used in the manufacture of these wires is of the highest grade, being pure Para, and it is reported that they are giving the very best satisfaction wherever they have been used.

The Bain Electric Manufacturing Co. have furnished a specially designed direct coupled generator to the Patton Motor Co. This machine is connected direct on the gas engine shaft and develops over 30 electrical h. p. at 250 r. p. m. It operates very well in every respect, running with no sparking and perfectly cool; Mr. Patton is delighted with it and satisfied that the efficiency is from 85 to 90 per cent.

The Patton Motor Co. have just completed one of their new cars, equipped with direct connected generator which was designed by Mr. Foree Bain. The truck is of special pattern having six wheels and runs without any noticeable oscillation over even rough track. This car makes a speed of from 25 to 30 miles an hour and gives excellent satisfaction. They are now building a number of similar cars.

Mr. Chas. G. Burton, city selling representative of the C. & C. Electric Motor Co., is kept busy making sales of these well and favorably known machines. Mr. Burton is one of the old timers in the electric light and motor business, having been connected in a selling capacity with several of the prominent companies for many years and is known all over the West as an energetic hustler.

Taylor, Goodhue & Ames, Monadnock Building, are very much pleased with their opening business, many orders coming from the country. They recently sold a large number of arc lamps to one plant. Satisfactory orders are coming in daily. Columbia lamps are selling well and giving great satisfaction to all using them.

Mr. J. K. Pumpelly, the well-known storage battery inventor, is perfecting a new form of cell, one of the features of which is a special porous partition and retainer. This battery, it is stated, is a new departure and is remarkably cheap and efficient.

The Railway Equipment Co., Pullman Building, Chicago, are doing a large volume of business. The demand for their electric railway supplies has been unprecedented recently. They have had hard work to fill all their orders with the promptness for which they are noted, but by strenuous efforts have succeeded in keeping up pretty well with their orders.

Wm. Hood & Co., managers of the Chicago office of the Electric Manufacturing Co., of Oconto, Wis., are receiving numerous orders for Brilliant incandescent lamps. It is a familiar daily sight to see Brilliants being shipped out in barrel lots to all parts of the country.

Mr. R. Fleming, electrical engineer, who is associated with the Rockford Electric Manufacturing Co., of Rockford, Ill., as superintendent of their shop, was in Chicago last week and found time to drop in at the Western office of The Electrical Engineer.

The Rockford Electric Manufacturing Co., of Rockford, are just installing a 500 incandescent lighting plant in the Chicago Oyster House. This adds another to the numerous plants they already have here for lighting and power service.

Clark & Marshall, 413 Rookery Building, Chicago, will soon have their new pamphlet of their numerous specialties ready for distribution. This is a very complete little work and shows the advantages and merits of the goods they handle.

The Central Electric Co. are meeting with great success as usual on Okonite wire, a very large amount of which is being used for the extensive new construction work and additions now going on.

Mr. Love, manager of the Chicago office of the Pond Engineering Co., reports having several important contracts on hand for complete steam plants for electric lighting and railway work.

Mr. L. K. Comstock, consulting engineer and contractor, 1419 Monadnock Building, Chicago, is busy installing motor and lighting plants and on various lines of consulting work.

Mr. S. M. Hamill, secretary and general manager of the Brush Electric Co., Cleveland, Ohio, was among the recent electrical visitors to Chicago.

PHILADELPHIA NOTES.

The New Odd Fellows' Hall Plant.—After months of great anxiety on the part of the several firms competing for the work, the contract for the steam engines and electric lighting plant of the new Odd Fellows' Hall, Philadelphia, has been awarded to M. R. Muckle, Jr., & Co. The plant will consist of three 10″ and 18″ x 10″ Westinghouse compound engines driving three 425 ampere dynamos to supply the entire lighting of the building. The dynamos will be of the slow-speed type and in all probability rope drive will be used. The special features called for in the fitting up of the lodge-rooms and degree-rooms will make this a particularly interesting installation. The building will be a very handsome one and is to be completed by the middle of 1894. It is certainly a sign of improvement in the times when contracts of this kind are let so far in advance as to enable the parties doing the work to have every opportunity, as the building progresses to make an installation which shall be well planned, thorough, and not expensive to run when completed. It is also interesting and encouraging to notice that five responsible bidders on a contract aggregating nearly thirty thousand dollars were all within a few hundred dollars of one another.

NEW YORK NOTES.

The Alexander-Chamberlain Electric Co., of 126 Liberty street, N. Y., have been appointed special agents in New York and vicinity, for the Riker Electric Motor Co., of 45 York street, Brooklyn, and though the representation is not exclusive they have already disposed of about 300 incandescent lights capacity for the Riker Co. who report a lively and increasing demand for their apparatus.

The Conduit Wiring Co., of 12 West 29th street, this city, installed the electrical part of the decorations for the Hotel de Logerot, to which a gold medal was awarded by the Committee on Art of the Columbian celebration.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.***

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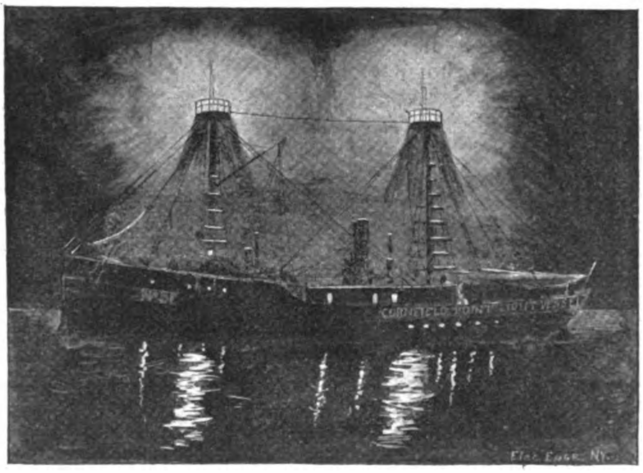
THE FIRST ELECTRIC LIGHTSHIP—THE ELECTRICAL EQUIPMENT OF "No. 51."

BY

George Barton Muldaur

IN view of the rapid advancement of engineering science and the state of perfection to which the art of shipbuilding has been reduced, it seems rather odd that so indispensable a public servant as the lightship should have been so long left in an almost primitive stage of development. These vessels, moored at points along the coast where lighthouses cannot be built, and where, but for a permanent signal of some kind, lives and cargoes would be constantly sacrificed, are massive old tubs, staunch and reliable, it is true, while securely anchored but almost helpless when, as not infrequently occurs, some more than usually severe storm compels them to slip their cables and drift out to sea. They are built to float, not to sail, and when missed from their proper positions must be searched for and brought back by tugs or government vessels. The Cross Rip lightship in Nantucket Sound was once lost for more than a month and was finally discovered in the Gulf of Mexico with all hands safe, but subdued.



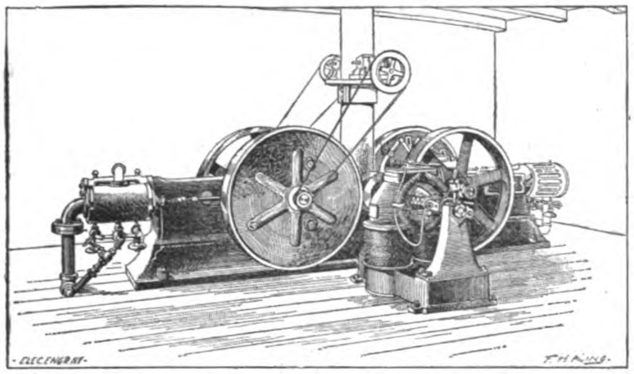
LIGHTSHIP No. 51, WITH ELECTRIC LANTERNS.

Then, too, in regard to the lighting; an immense lantern containing eight lamps with their reflectors is arranged to surround each of the two masts, and can be raised at night and lowered in the morning by the aid of a counterpoise weighing a ton. As the lantern, of course, is equally heavy, this weight is always at the top of the mast and adds greatly to the vessel's tendency to roll. At the base of each mast, and completely surrounding it, is a little house built on a raised platform and having a slanting roof that opens to receive the lantern and shelter the men while tending it. As the real masts are thus used exclusively as derricks, a supplementary mast is provided about four feet abaft each light mast, and on these are carried fore and aft sails to be used in case of emergency. The complete equipment is extremely antiquated in design and clumsy in appearance, though picturesque enough and affording, perhaps, the only remaining parallel to the good old days of the whalers.

Sentiment and poetry can readily be dispensed with, however, where safety to life may be secured by methods of practical utility, and four new vessels have accordingly been built at the yards of Messrs. F. W. Wheeler & Co., of West Bay City, Michigan, designed by Mr. Walfrid Sylven, C. E., a superintending engineer of the Lighthouse Establishment, under the personal direction of Commander Geo. W. Coffin, U. S. N., Naval Secretary of the Lighthouse Board. They are iron steamships of the most approved design, capable of sustaining a sea speed of nine knots per hour and of taking care of themselves in storms. The first of these, known as "No. 51" and to which will be entrusted the guardianship of Cornfield Point in Long Island Sound, has been fitted with a complete electric plant under the direction, and at the suggestion, of Commander Coffin, and in accordance with the specifications of Major D. P. Heap, U. S. A., engineer of the Third Lighthouse District, with headquarters at Tompkinsville, Staten Island, and is the first electric lightship in the world. Commander Coffin and Major Heap have long been firm in the belief that the incandescent electric light was perfectly adaptable to lightships, certain authorities to the contrary notwithstanding, though the white rays of the arc light are said to be more readily absorbed by fog than those of the oil lanterns in general use, the latter having a yellowish tinge that shows in a fog by contrast.

The incandescent light has, therefore, been employed on No. 51, and the utmost care has been taken to foresee and provide for all possible accidents to any part of the plant. The entire equipment is in duplicate. The dynamo-room, consisting of a deck house at the foot of the after mast, contains two Thomson-Houston dynamos wound for 110 volts and having a capacity of 100 lights each. These are driven by two Ideal engines of eight horse power each, running at 400 revolutions per minute. The dynamos are fitted with Evans friction cones, and the arrangement is such that each engine can run either generator or both, if desired, the change being made very rapidly by means of double-acting ratchets and sliding bed plates. The actual floor space occupied by the dynamos and engines does not exceed nine by eight feet. Each dynamo is amply capable of lighting the entire vessel by itself, but two are used for the sake of safety. If desired, either generator can furnish current to the mast-head lights and the other one to the lamps below decks, and in fact, the whole system is entirely interchangeable. Duplicate armatures and rheostats are kept ready for emergencies in addition to such accessories as brushes, switches, fuse blocks, etc.

The mast-head lights consist of eight 100 candle power lamps, four on each mast in multiple. Each lamp is placed in a separate lantern with the triple loop of its filament in the focus of the lens, and the four lanterns are symmetrically placed about the mast-head. Lead-covered Habirshaw cables of seven strands imbedded in the masts carry the current to these lights. If, in spite of all the precautions that have been taken, the electric plant, or a part of it, should become disabled, the lamps may be quickly removed from the lanterns, the sockets instantly moved out of the way, and oil lamps substituted while repairs are being made. The lanterns, it should be added, are swung on trunnions to keep the beam of light horizontal. In order to distinguish one from another, light vessels, as well as lighthouses, are provided with revolving lenses, making flashes of a certain duration; thus a ten second flash with a five second interval may show the pilot who has lost his bearings that he is not far from the right course, while a twenty second flash and a fifteen second interval shows him that he has been driven away up the coast and is in the neighborhood of a dangerous reef. The combinations are infinite and each has its especial significance. In this instance, however, instead of the heavy revolving lens operated by a separate engine and requiring careful attention, a very simple interrupter is employed, regulating the length of the flash to a nicety, and entirely automatic in its action. This little device consists of a ratched shaped cam revolved by means of a worm gear at a speed of one complete turn per minute, and divided into the proper number of steps to produce the particular number of flashes required. The gearing is run by a light helical wire belt from the engine shaft. The cam is made of hardwood with every alternate step covered with copper, and upon its face bear two brushes side by side, but insulated from one another, and included in the mast-head circuit. As the cam revolves, therefore, the circuit is alternately closed and opened at sharp intervals. The whole apparatus is only about ten inches in height and stands on a little bracket above the dynamos. The flashing device also throws in a resistance, equal to the resistance of the mast head lights. When the latter are extinguished, this prevents the other lights in the ship from flickering.



Dynamo Plant of Lightship No. 51.

The wiring of the entire vessel is most carefully and thoroughly done. About twenty lights are used for the necessary illumination between decks. In all cases, the wire is capable of carrying twice the current required without heating, and no effort has been spared to make this installation perfect in every respect. The success of the experiment is a subject for sincere congratulation to all who go down to the sea in ships, and to the electrical engineer, who sees in this experiment another glimpse of the vast possibilities of his profession.

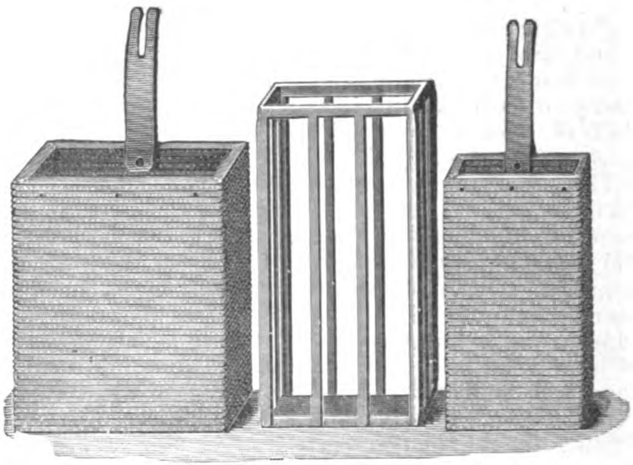
THE SCOTT FLASH SIGNALING LANTERN.

The Brazilian cruiser "Tiradentes," built and equipped at Elswick, went through her trials a few weeks back. After the trials the signaling lamp, invented by Commander Scott, of H. M. S. "Excellent," was exhibited and created great interest. The lamp in question is designed to send signals by the usual flashing method. The lamp can be placed on the top of the mast, or on a special signaling pole; an all-round sphere of action is therefore afforded to it. The operator, however, can be posted wherever convenient. He works the lamp by means of a key. Each time the key is pressed the lamp emits a flash, shutters surrounding a glow lamp being actuated by a system of electromagnets.

THE NEW ELIESON ACCUMULATOR.

In the accompanying drawing we illustrate a new form of accumulator invented by Mr. C. P. Elieson. This accumulator is built entirely on the Planté principle, and it will easily be perceived that although it is only composed of two electrodes, a large amount of surface is, nevertheless, provided for the storage of electrical energy. In the accompanying illustrations for which we are indebted to the London *Electrical Review*, there are shown the three parts composing such an element, Fig. 1 being the negative electrode, Fig. 2 the separator, and Fig. 3 the positive electrode. The positive electrode is inserted in the skeleton box, Fig. 2, the whole is then placed into the negative electrode; a hard rubber box is provided with a rim extending one inch from the bottom of the box, upon which rim the negative electrode rests so as to prevent any possible short-circuiting from the agglomeration of oxide dropping at the bottom. Fig. 4 gives a view of one electrode, where a portion is removed in order to show the internal construction; it is built up of a series of corrugated and perforated envelopes of thin lead. Each of these envelopes is built up on top of the other, and each corrugation is so arranged as to run across or at an angle with the corrugation of the next envelope; in practice, nine of such envelopes compose one electrode. The positive electrode, 5 x 3½ x 8 inches, possesses 4,000 square inches of exposed surface, the negative electrode measures 6½ x 4½ x 8 inches. The lugs which are on each electrode run right to the bottom and are burnt through and through in order to secure a perfect metallic connection with each envelope. The weight of the two electrodes is 12½ lbs., or 23 lbs. including box and electrolyte.

It is claimed that such an accumulator requires very little attention, and that the positive electrode will hardly require renewing after 12 months' hard work. The formation process is carried out in the usual way, partly chemically and finished off electrically. The storage capacity of this cell is about 100 ampere hours, but the formation can be stopped at 60 or 80 ampere hours, as it will soon increase in its capacity while in actual work.



Figs. 1, 2 and 3.—New Elieson Accumulator.

It is clear that buckling in this form of accumulator is totally obviated, at least during the first year of work, as there is ample space between the corrugations to allow for the molecular increase of oxide, but the total filling up between the several enevelopes could not, it is claimed, take place before two years of constant work. Although at that time this accumulator would have attained its highest degree of capacity, it would be advisable if used for traction to renew the positive electrode after twelve months' working during which time, it is claimed, no attention whatever would be required beyond replacing the electrolyte lost by evaporation.

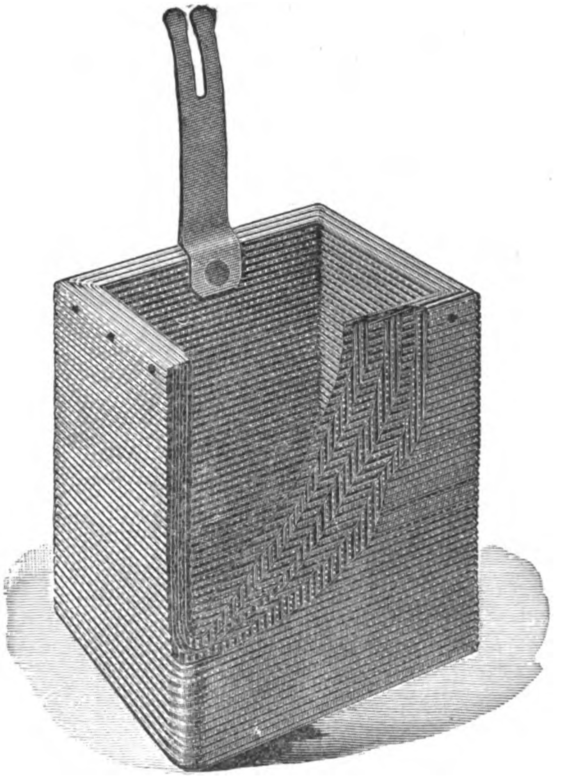


Fig. 4.—New Elieson Accumulator.

THE SOLAR CONSTANT.

BY

I. Thornton Osmond

In 1886, I devised some experimental tests of Maxwell's electromagnetic theory of light, some of which were subsequently executed, and a few notes concerning them published in The Electrical Engineer, March, 1889. The apparatus and the conditions of work, at the Pennsylvania State College, were so poor that it was impossible to be certain of the results. In September, 1889, Dr. Sheldon published, in *Silliman's Journal*, an account of similar experiments, on the same principle but with better apparatus and conditions, in which he claimed a positive result. Dr. Brackett repeated the experiments, without result, and believes Dr. Sheldon to be mistaken.

But direct experimental proof of Maxwell's theory is no longer necessary. The work of Dr. Hertz and of Mr. Tesla has established the identity of certain electromagnetic actions and light. The solar radiation is an electromagnetic action, a transmission of energy in the electromagnetic form or state.

All attempts to determine the *solar constant* have assumed that the energy is either in the form of heat or in some form *totally convertible* into heat by the apparatus used. If, then, this be not true, we have as yet no measure of the flow of energy from the sun upon the earth. It is now certain that the energy of the solar beam is not heat, that it is electromagnetic in its nature. That the apparatus used to measure the energy thus transmitted should have an efficiency of 100 per cent. as a converter of electromagnetic into heat energy appears very improbable.

I have tried to gain a little knowledge upon this subject by some experiments. The apparatus consists of an eight-pole Westinghouse alternator, running at 2,000 revolutions per minute, at 1,000 volts, a Stanley transformer (10:1), an induction coil of special construction, thermopiles and galvanometer, or delicate thermometers.

The induction coil was made especially for this work. The outer coil is 6½ inches long, wound on a spool 5½ inches in diameter, 1,456 turns. This spool has a hole 2¼ inches in diameter, for the inner coil leaving a wooden tube with walls 1¼ inch thick between the coils. In these walls, on two opposite sides, pockets of the same width and nearly the full length of the coil are formed, parallel to the axis and between the coils. In these, substances may be placed or rubber or glass tubes may be filled with substances and inserted. The relative efficiency of two substances as converters of the electromagnetic energy of a field into heat is determined by delicate thermometers or the thermopile and mirror galvanometer, together with the mass and specific heat of the substances.

Several trials of mercury and iron (fine turnings) indicate the latter to be at least as efficient as the former in converting electromagnetic energy into heat. (Aside from other difficulties, it is almost impossible to know with precision the relative amounts of energy that will pass through the same form and volume of mercury and of iron filings similarly situated in the same electromagnetic field.)

Experience with transformers in electric lighting has shown that in good iron but very few per cent. of energy is lost in heat in the iron core. Suppose that poorer iron converts even as high as 10 per cent. Then, if mercury is a less efficient converter of energy of the one form into the other, it converts less than 10 per cent. And the value of the *solar constant* determined by the heat evolved in mercury is *less than* 10 *per cent. of its true value.*

Through every square metre area perpendicular to the solar radiation, if I am not greatly in error, there flows at least 1 h. p. of energy, and that already in the most valuable form known. Its utilization, direct and unconverted, is the last great problem in rendering all the powers of nature tributary to the service and well-being of man.

ARTIFICIAL INDIA-RUBBER.

Dr. W. A. Tilden discovered some months ago that isoprene, which can be prepared from turpentine, under certain circumstances, changes into what appears to be genuine india-rubber. Bouchardat had also found that the same change could be brought about by heat. The material so produced resembles pure Para rubber in every way, and, whether it is genuine rubber or not, it may be equally good for all practical purposes. It vulcanizes, for instance. It therefore seems possible, says *Industries*, that we may soon be able to make india-rubber commercially. If this is possible, a fortune awaits the inventor who can make good rubber from turpentine at a reasonable price. It is a subject well worthy of the devotion of prolonged labor.

THE MAGNETIC CLUB.

The autumn meeting of the Magnetic Club will be held at Morello's, 4 West Thirty-ninth street, on November 16. Dinner will be served at half past six o'clock, and a full attendance of the members is requested.

THE KEYSTONE REVERSIBLE MOTOR FOR ELEVATOR SERVICE.

The growing demands of the electric elevator field continue to attract the attention of progressive inventors and manufacturers. The constant addition to the number of high office buildings and factories, and their contiguity to central stations in all large towns and cities, offer a strong inducement to study the problems involved in equipping them with electric elevators and to produce the apparatus needed.

Among the concerns that have paid special attention to this field for some time past is the Keystone Electric Company, of Erie, Pa., who have already introduced a large number of their equipments with great success; and we are now afforded the opportunity of illustrating and describing their devices and methods, the main feature being their use of the reversible motor, to which reference has been frequently made in these columns.

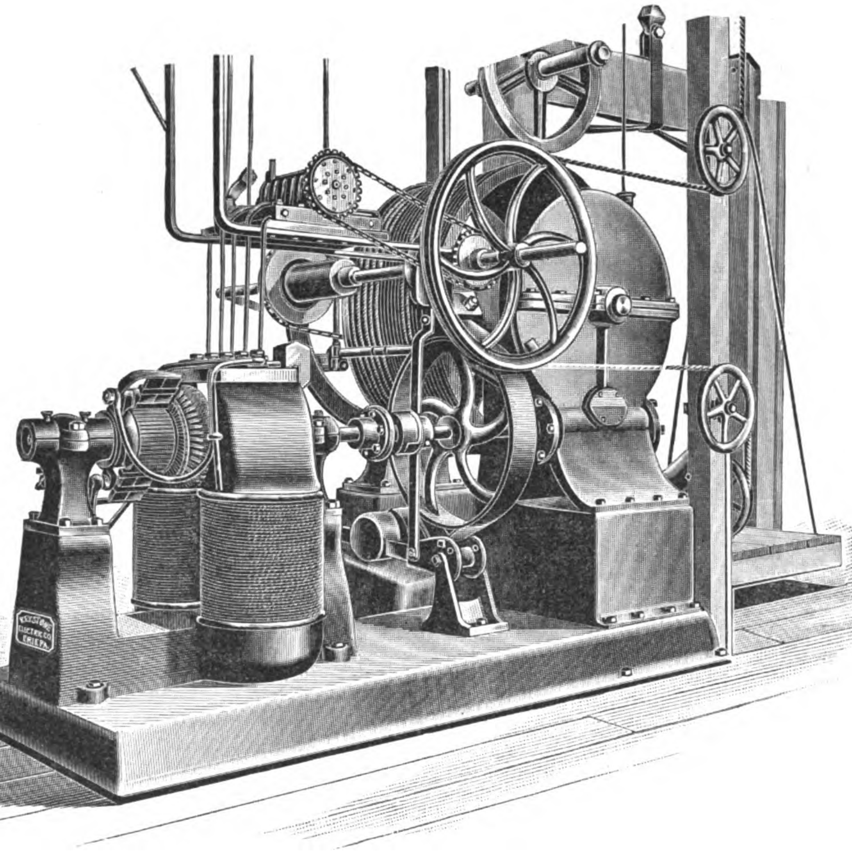


Fig. 1.—The Keystone Reversible Motor Attached to Elevator Winding Drum.

Fig. 1 shows a motor of the Standard type coupled direct to worm shaft of winding gear of an elevator made by Marshall Bros., Pittsburgh, Pa. The car speed of this machine is 200 feet per minute with a load of 1,000 pounds. In operation the machine is practically noiseless, with easy stopping and starting speeds. The reversing switch is placed directly over the motor, with feeder wires coming from above, with short wires from switch terminals to motor binding posts. In this form it is very convenient to wire and occupies but a small space. A sprocket chain connects the switch and brake shaft. This brake shaft is also connected to the shaft of the cable drum, by chain gear, to stop the motor automatically at the top and bottom of the hoist, by operating the switch and the brake at the same time. This same simultaneous operation of switch and brake is controlled by hand cable for stopping at different points, or at the several floor landings. The chain gear used prevents any possible failure of brake and switch operating in unison and in proper time to perform their proper part of the work of controlling the brake and the motor to stopping and starting. The brake is so constructed that upon closing the switch, the brake is instantly released. The car starts with an easy motion when the switch is opened, the brake closes gradually and brings the car to an easy stop.

The frame of the motor is insulated from the iron base of the winding machine. An insulated coupling is also used to provide against any grounding of the circuit through the motor frame and the iron base. The coupling is provided with a crab set apart to allow for any end thrust that might occur by neglect or wear of the worm shaft. The sprocket wheel on the switch is insulated to prevent grounding of the circuit through the hand cable, or through the iron frame of the winding machine. In fact, nothing is left out which in the least could add to the stability of the machine, and the Keystone Electric Company are proud of the fact that for the past two years that they have been installing these motors there have been no failures, while all machines are operating to the entire satisfaction of their customers.

Fig. 2 shows another type of reversible motor, with insulated crab coupling attached. This motor was designed to meet the requirements of elevator builders, for a machine with an armature shaft near the base to admit of building the elevator winding machine compactly. Fig. 3 shows this type of motor attached to the elevator made by M. J. O'Donnell & Co., Cleveland, Ohio, running at a car speed of 190 feet per minute. The frames of these motors are of soft steel castings with brass yokes, self-oiling bearings, with sight-gauges, showing the position of the oil. All terminals are concealed except those to the brushes. The commutators are of tempered copper made with large brush contacts. The bearings in this as in all machines of the Keystone make are designed for long life.

Fig. 4 shows the standard type of Keystone reversible motor for use on elevators where a belt is used to transmit power to the winding drum of the hoist. With this machine a single belt is used, the motor being reversed by means of a reversing switch operated by hand cable on the elevator car.

Fig. 5 shows a view of the reversing switch. It is constructed of heavy parts throughout to give strength and to provide ample contact points for any volume of current required on the largest motors at present used in this service. The base is made of strips of well-seasoned hardwood, glued and bolted together, forming a piece of proper size for mounting the switch. The main axis of the switch is of cast brass separated in the centre by one inch of fibre, with plates cast on the arms from this shaft. The bearings for this axis are of brass well fitted to the journals. On one outer end of this shaft is placed the sprocket wheel insulated with a fibre disc. On the other end is a snap switch constructed as shown. This snap contact closes the circuit just after all the plates have been brought in contact by the rotating switch; and opens the circuit a very little in advance of the plates leaving the contact, thereby bringing all the bad effects of breaking the circuit to that one point. By the snap action of the circuit breaker but little injury is done here. It is at this point only that any attention is required in operating the elevator. These switches have been used for the past two years and seem to be in perfect order. It has not yet been necessary to renew any part of those now in use. In view of the fact that elevator machinery is usually placed in the hands of employees who know and care little about the mechanism, the success of this motor is somewhat phenomenal.

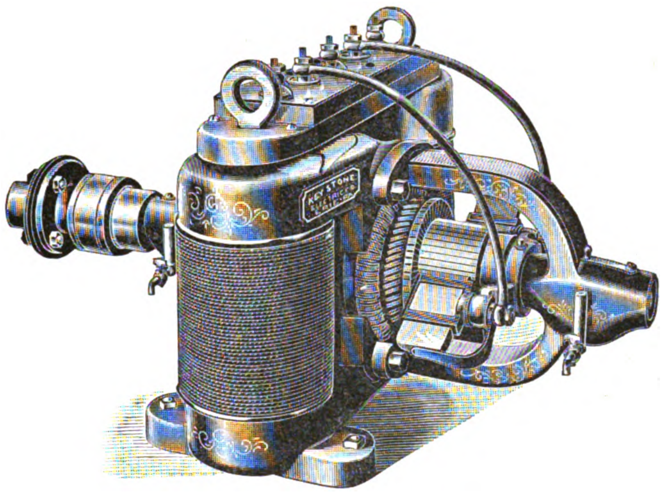

KEYSTONE ELECTRIC CO. ERIE PA.

FIG. 2.—THE KEYSTONE REVERSIBLE MOTOR WITH CRAB COUPLING.

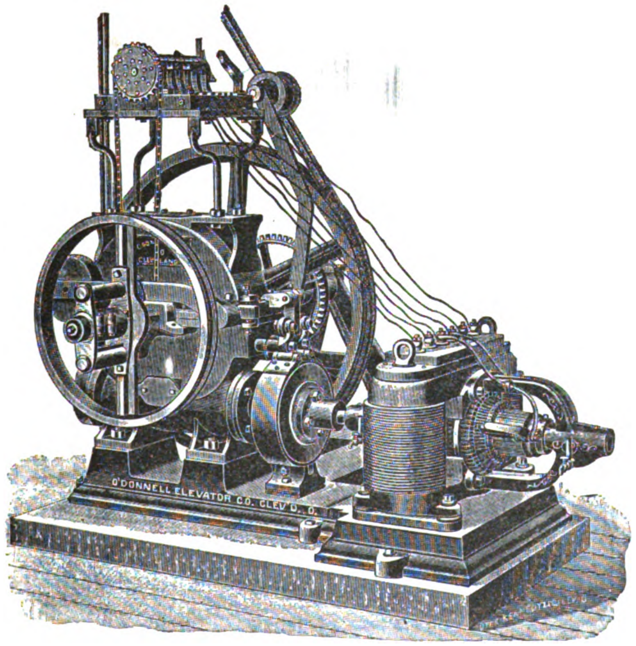

O'DONNELL ELEVATOR CO. CLEV'D, O.

FIG. 3.—THE KEYSTONE REVERSIBLE ELEVATOR COMBINATION.

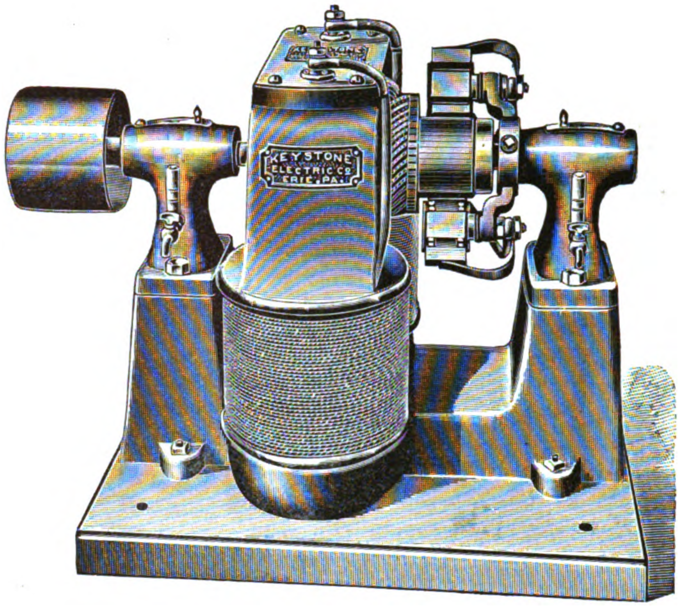

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FIG. 4.—STANDARD KEYSTONE REVERSIBLE MOTOR.

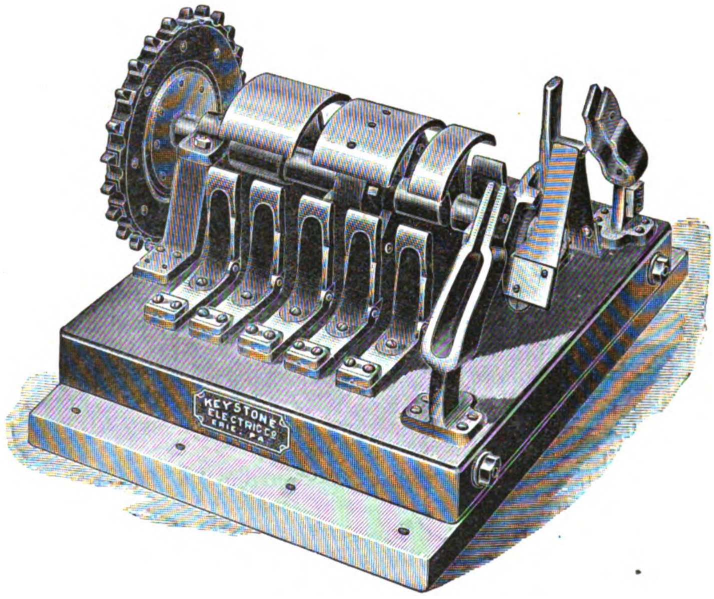

KEYSTONE ELECTRIC CO. ERIE PA.

FIG. 5.—KEYSTONE REVERSING ELEVATOR SWITCH.

LUNCHING WITH A CONTEMPORARY.

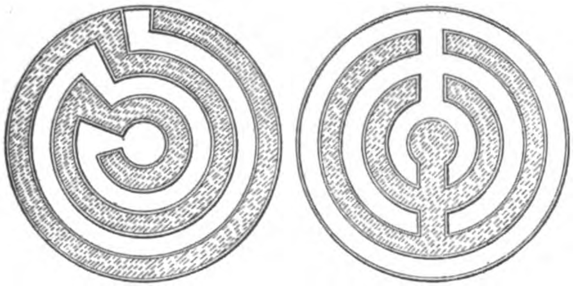
OUR esteemed contemporary, THE ELECTRICAL ENGINEER, celebrated the fitting up of its new offices in the *Mail and Express* Building with a delightful luncheon from twelve to three o'clock on Wednesday, Oct. 26. Messrs. Phelps, Colvin, Martin, Wetzler, Muldaur, Collins and Boughton received the 250 guests of the afternoon, who all complimented the paper on its handsome quarters.—*New York Electrical Review.*

A BIOGRAPHICAL SKETCH OF THE KHOTINSKY ACCUMULATOR.—V.

BY

Capt. A. de Khotinsky

The current density per square centimetre in charging and discharging distributes itself over the whole surface in inverse proportion to the resistance of the electrolyte, which touches said surface. From this it results that at the lower part of the electrode the action is more energetic than at the upper part, and therefore must result in an earlier destruction of the lower part.



Figs. 14 and 15.

To avoid short-circuit by ramifications I enveloped the positive and negative plates with parchment paper and filled the space with sifted river quartz sand. This improved accumulator worked more satisfactorily a longer time and no inner short-circuit existed. After some weeks, however, I observed that the potential commenced to fall. Measuring the potential of several of the cells, I found that some of the cells, at the beginning of the discharge, instead of giving the usual potential difference of 1.95 volts, gave only from 1.8 to 1.85 volts. To my surprise, the dropping off of the potential existed only in such cells in which the spaces between the electrodes had been filled with quartz sand. Closer examination of these cells showed that at the time of the highest charge, in the upper part of the positive plates, the liquid displayed a bright purplish red color which occurred at the time the highest development of gas by the positive plates took place. On ceasing to charge, these colors turned pale and became yellow in the beginning of discharging, and during the continued discharging there were formed, at the upper part of the positive plates, bright yellow crystals which by and by, on contact with air, changed into a brown powder.

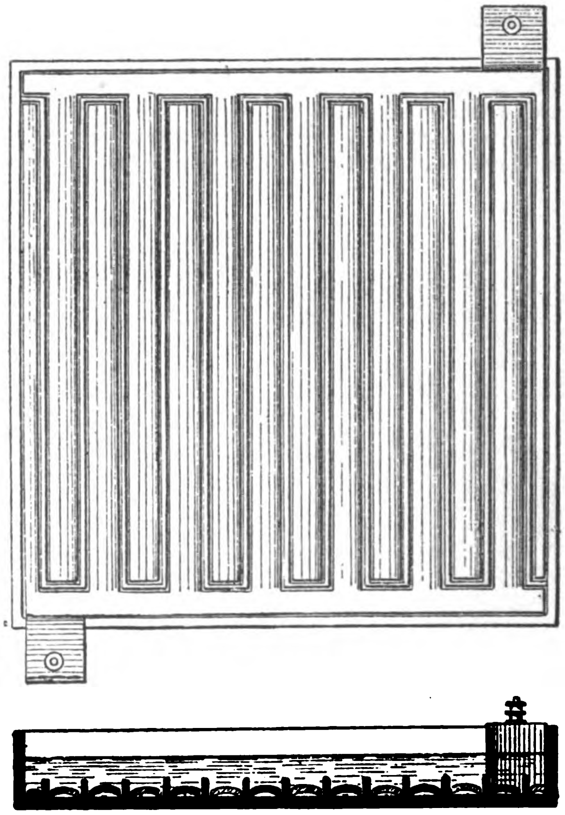
The chemical analysis of the purple red liquid and the crystals proved the existence of iron and showed that they must have originated from combination of iron and acid. The opposing E. M. F. of the iron must also have caused the fall of potential in the cells. The iron must have been reduced from the quartz sand, which always holds traces of iron ore. I learned from this occurrence how exceedingly important it is in making accumulators to use only chemically pure materials.

At that time, it was customary to make the connections between the cells of copper, and the binding screws of brass. In charging the elements these parts were oxidized and converted into lumps much like mushrooms by the acid, and the contact, therefore, became so defective that heating took place. Owing to the heating, the oxide dried and the contact ceased entirely. This led me to make all connections in a battery, of lead only, and to make all contacts exclusively by melting together.

Previous experiments in England with secondary batteries had already caused the thought to arise in my mind to arrange the electrodes in a horizontal position. During my work in Rotterdam this thought was not mature enough to put it into practical use. I was therefore compelled, in the case of the battery first built, to still make use of electrodes in a vertical position. All unsuccessful experiences I had had with vertical plates confirmed me in the adoption of the horizontal arrangement of electrodes to avoid these failures, and for the following reasons:

1. The falling off of active matter from the electrodes can not exist in the horizontal position, because the electrode is put on the bottom of the vessel at the start. 2. Internal short-circuit by the touching of electrodes was impossible, when a partition wall, higher than the electrode itself, separated the positive and negative from each other. 3. Local action cannot exist, because the horizontally formed surface of the electrode is perfectly parallel with the layers, which form the specific weight of the acid. 4. Rapid destruction of the electrodes at only one place, in the vertical position at the lower part, by the flowing in of the stronger acid is unavoidable. In the horizontal position of the electrode this is avoided, because the electrode has its whole surface surrounded with acid of exactly uniform specific gravity.

Figs. 14 and 15 show the different arrangements for horizontal position of the electrodes. The first experiments with cells in a horizontal position I made in hard rubber trays of 25 x 25 x 5 cms. The bottom of these trays I covered with lead 0.6 mm. thick, and this lead I overlaid with spongy lead 4 mms. thick, as shown in Fig. 16 and 16 A. Other trays of the same kind I covered with different kinds of lead oxide instead of spongy lead. These experiments gave the expected good result of laboratory work for primary and secondary batteries.



Figs. 16 and 16A.

When, however, I turned to practical experiments with these cells, many deficiences showed themselves. Thus, when I had to make one of a capacity of only 40 ampere hours per cell it proved necessary to construct a vessel of 80 x 80 x 5 cms. The inconvenience caused by the great size of the vessel led me to form the oxide in thicker layers. The result of this was greater external resistance, while the weight of the active matter was too great in comparison with the surface of contact. I could not discharge this thick layer of oxide in 8 to 10 hours, as was desirable, with a discharge diagram sufficiently horizontal, but it required 18 to 20 hours to discharge the whole capacity.

To remedy this defect I sought to materially increase the contact surface for the same weight of oxide in the given space, and to begin with in the following way: I prepared a frame work for the positive electrodes of perforated lead strips 10 mm. wide, 1 mm. thick and 42 cms. in length, which I soldered together at distances of 3 mm. by means of vertical connecting strips (Fig. 17). I filled the framework with chemically pure crystallized red lead, so that the filling through the holes could unite into one solid mass with the framework.

The negative electrode skeletons were made in a similar way but with this difference, that the lead strips were not punched through and were only ½ mm. thick, and the distance, therefore, amounted to 5 mm. For filling the negative a mixture of litharge and red lead was used.

This accumulator, the dimensions of which were 45 x 45 x 7 cms., contained 10 kilograms of lead and oxide, 4½ kilograms of 10 per cent. acid The weight of the containing cell amounted to 5½ kilograms; consequently the total weight was 20 kilograms. With an 8-hour discharge its capacity was 100 ampere hours, with 10 per cent. drop in potential.

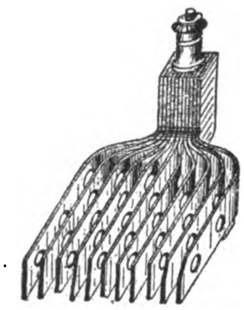


Fig. 17.

While I was occupied with this accumulator, in the beginning of my experiments, for which I made four cells, my company had negotiated with the Frankfort Co. in connection with the Electro-Technical Manufactory, of Cannstadt. A commission from this company, under direction of Prof. Dr. Dietrich, of Stuttgart, came to Rotterdam in November, 1884, for the purpose of examining my new accumulator. Prof. Dietrich was well satisfied with the tests already made, but expressed a desire to make more complete tests with the accumulator.

In the meantime I was more and more convinced of the good quality of my accumulator with horizontal electrodes. I proposed to my company to discontinue the experimental lighting with vertical accumulators, the batteries of which were set up in two boats, and proposed to light one block of houses by means of a combined system. accumulator and dynamo on the same circuit, and to use in that the new horizontal accumulators. This proposition was accepted after Prof. Hospitalier, of Paris, had given his approval and commended it. I put up the block station at Boomjes, in Rotterdam. It was designed for 300 glow lamps, and in March, 1885, it was put in operation.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the Institute headquarters, 12 West 31st street, this city, on November 15 at 8 p. m., Dr. J. B. Williams will present a most interesting paper on "Oil versus Air as an Insulating Medium," and make a number of remarkable tests and experiments, not only with oil and air but with samples of insulated wire.

THE USE OF STORAGE BATTERIES IN CENTRAL STATIONS ABROAD.

BY

RECrompton

I have read with interest the leading article on storage batteries in The Electrical Engineer of August 31. As I personally have been responsible for putting in a very large proportion of the storage batteries used in our English central stations I am in a position to correct and to supplement the information furnished to you by your informant. It is evident from his statement that if he did not discover any instances in Europe in which the battery came into use at times when the load became abnormally heavy, it was because he had not pursued his inquiries very far. I could name at least a dozen large central stations where the battery does come into use at the time that the load is heavy. For instance the central station at the Schenkenstrasse at Vienna, which supplies the large theatres, has not sufficient dynamo plant to supply more than one third of the maximum load at times when some of the great scenic changes take place in the Grand Opera. During these short periods of maximum demand frequently three-fourths of the total load is supplied by the accumulators. This station has been at work for nearly eight years and from its commencement has always worked well. The running expenses both in fuel and in maintenance even now contrast very favorably with any other stations on the continent of Europe. Turning to our English stations, if your informant had made careful inquiries at the one which has worked longest, namely that belonging to the Kensington & Knightsbridge Co., at Kensington Court, from which station an absolutely uninterrupted supply of electricity has been furnished since the year 1886, he would have been shown that a considerable slice of the peak of the load diagram during the winter months has been supplied by the batteries. During the summer months we found the most economical mode of working is to furnish the entire load from the accumulators for as many hours as possible and as we frequently can do this from 11 p. m. to 3 o'clock in the following afternoon, we have every object to gain in leaving our accumulators fully charged at the time we stop the running machinery at 11 p., m. so that we arrange not to take any charge from the accumulators during these running hours, But in winter the case is widely different; the hours during which the load is sufficiently light to be furnished from the accumulators by themselves only extend between 1 a. m. and 5 a. m., and for such a short run it is not necessary to start with the accumulator quite full, so that the engineer in charge may, if he finds it convenient to do so, supplement his dynamo plant by drawing from the accumulators during the hours of maximum load. Of course the mode of procedure varies very considerably according to the amount of generating plant in the station, as on this side of the water our central stations are nearly all of them only partially filled with generating machinery to which additions are made from time to time. It follows that as the increase in load gains on the generating plant installed we have to supply more and more of the maximum load from the accumulators; but on the other hand immediately after an additional instalment of generating plant has been put down it may for some months be sufficient to meet the entire load without any aid from the accumulators.

Your informant is quite correct in pointing out that one of the great differences between your American practice and our English practice is that in the latter case our periods of maxim load extend over very short times even in winter. This is due to the fact that such a large number of Londoners dine in their own houses at the same hour, 7.30 to 8 o'clock. Just at this time the whole world dresses for dinner and a large number of bedroom lights are turned on. By 8 o'clock, however, every one has left his bedroom and at the same time the early closing shops switch off their lights so that the maximum load falls by 8 o'clock to a point not two-thirds of its previous value between the hours of 7 and 8. I think this extremely high peak on our load diagrams is principally due to the very large number of private dwelling houses attached to our London central stations. I am informed that you have very similar peaks to load diagrams of various American supply stations, so I think it is extremely probable that these same stations would benefit economically from the use of accumulators as much as we do on this side.

I cannot follow your informant's remarks about the batteries themselves requiring a wonderful amount of care and attention; it is true that in the care of accumulators as in the care of any class of machinery we find it more economical to make a small repair immediately the defect is observed instead of waiting for the defect to develop itself and consequently necessitating a much more costly repair; but it is now proved beyond doubt that the cost of upkeep of accumulators can be quite as small as that on any of the central station machinery. What he characterizes as the care of sick cells has now resolved itself into a very simple matter. It took years of observation and experience to determine the cause of certain cells occasionally losing their capacity and consequently being liable to be reversed and sulphated each time that the battery discharged at its normal rate. Recent research however has shown that this mysterious defect is entirely due to the use of impure sulphuric acid. It is very easily cured as the sulphuric acid can be freed from the impurities which cause the mischief at a very trifling expense; but before this matter was thoroughly understood such cells as contained impure acid did undoubtedly require extra care and attention to keep them in order.

There is one point on which your informant did not dwell so much as he might have done, and that is, that the engineers in charge of central stations containing storage plant are relieved of an immense amount of mental anxiety and worry. None of the accidents to the running machinery which are liable to occur in the very best designed central stations can affect the steadiness of the light. Even the burning out of the armature of a 200 h. p. dynamo when it is supplying one-third of the total load of the station hardly produces a perceptible flicker of the lights if accumulators of sufficient size are used in parallel, whereas without their aid such an accident would make the whole of the lights served from that station jump and oscillate to such an extent as might easily cause a panic and hence an accident in a theatre or place of crowded assembly. There are many other minor accidents that can and do occur in the best central stations and which must always cause flickers in the light unless accumulators are used. We have instances in London of a boiler safety valve being displaced and hence the whole of the steam supply of a central station failing for a period of 10 minutes or so, the whole load being thrown on the accumulators. The lights were maintained with only a slight drop in the volts and this without the accumulators themselves being damaged by the extra demand made on them.

SIGN PAINTING THE CLOUDS.

Mr. Sydney Hodges, of Ealing, England, has succeeded in projecting a large and highly luminous letter on the clouds by means of an invention of his own. This latest application of the electric light was witnessed by himself, his friend Col. Marsh, of the Royal Engineers, and by an assistant engineer of the electrical works at the Horticultural Exhibition.

AUTOMATIC REGULATION OF WATER WHEELS FOR ELECTRICAL WORK.

BY

J. E. Pritchard

In dealing with this question, the most important matter is very often overlooked, viz., the gate rigging of the wheel to be regulated. We very often hear the remark made, that there is no governor sufficiently sensitive to regulate a wheel for electric work. This is a mistake. It is very easy to procure a device that will move the gates rapidly enough, but the difficulty exists in the fact that water, being practically incompressible, it is an impossibility to regulate the flow with any degree of sensitiveness. This point is very nicely covered and made plain in an article in The Electrical Engineer of Sept. 14, 1892, headed, "Governing Water Wheels, a Suggestion and an Inquiry."

In the selection of a wheel for work requiring close regulation, one should be chosen having a gate that tends to close when the water is flowing through it. By having this feature, it will readily be seen that the movement of the gate will be prompt, as there is time lost in taking up back-lash, torsion in gate shafts, etc. It is very important that the gate respond to the slightest movement of the governor within the least possible time. By the adoption of a wheel that possesses this feature, it is a comparatively easy matter to regulate sufficiently close for lighting or textile fabric work.

With electric railway work, I have found it an impossibility to do the work of regulating the wheel with any degree of satisfaction. The difficulty encountered is fully described in the above-mentioned article, and is a very serious one. In dealing with this question at Oswego, N. Y., I overcame the difficulty in a very satisfactory manner, by the introduction of an automatically varied load, which, practically, held the load on the generator constant. It consisted of a rheostat of iron wire of a capacity nearly equal to the gross output of the generators. This rheostat was composed of No. 17 B. & S. (common stove pipe) wire in sections. The resistance of each section was sufficient to allow a leakage of eight amperes at a pressure of five hundred volts.

By the use of an automatic device, these sections were cut in and out of action in proportion to the speed of the generators. With a normal speed, none were in action; as the speed increased, the devices cut in one after the other and at the time the speed was in excess of normal from five to seven per cent., there was the same load (electrically) on generators as when running at normal speed. By the use of this device, which is still in use, the regulation was accomplished in a very satisfactory manner.

The principal objection to using this scheme is, that the same amount of water is used with light load as with heavy load; but as a rule, where water power is cheap enough to make it preferable to steam, there is a surplus of water, and this objection is reduced to a minimum.

I have experimented with a water wheel governor in connection with this device, but as a whole, it has not been satisfactory. With the above described device, I found that all that was necessary was to open the gates to a point sufficient to carry the greatest number of cars to be used for the day. That point once reached, nothing more was required. It was connected in such a manner as not to interfere with the automatic circuit breakers, and in case of a short-circuit, the device came into action and prevented any undue speed.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can 'entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinsons only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. XIV. NEW YORK, NOVEMBER 9, 1892. No. 286.

In seeking out principles, the simplest instruments and experiments teach more than elaborate ones.—John T. Sprague.

STORAGE BATTERIES IN CENTRAL STATIONS.

PERHAPS in no branch of electric light and power work does American practice so differ from,—or as some contend, lag behind—that in vogue abroad as in the application of storage batteries as auxiliaries to the regular dynamo equipment of central stations. Whether the limited use of batteries in the United States is due to the prolonged litigation, now, happily, ended, or to a distrust of their reliability and endurance, the fact remains that we have been accused by European electrical engineers of neglecting what to them appears as a valuable adjunct conducing to economy in central station work. Our columns have lately contained a number of articles advocating the introduction of such auxiliary batteries, and giving apparently ample reasons in support of the European practice in this respect. It was with some degree of surprise, not to say disappointment, that we learned from a well-known electrical engineer, whose opinion we quoted in our issue of August 31, that while the central station battery plants abroad did good work in carrying the station over the period of very light load, no instance had come under his notice in which the batteries assisted the dynamos during the heavy load period. These batteries, also, it was claimed, required considerable care and delicate handling, and occupied a disproportionally large space, as compared with the dynamo plant. We might also, in this connection, recall the sentiment expressed by Prof. F. B. Crocker, in his recent lecture delivered before the New York Electrical Society, that a small auxiliary engine and dynamo could, in his opinion, be operated more economically, everything considered, than a battery plant.

Our editorial comments made in the issue above referred to, have served to call forth a communication from Mr. R. E. Crompton, of London, who has probably had as long and varied an experience in central station battery work as any electrical engineer in the field. According to Mr. Crompton, it would appear that our informant had based his opinion on too limited an observation, as Mr. Crompton cites several cases in which the batteries do assist the dynamos at the heavy load period. As to the care required by storage batteries, Mr. Crompton's experience leads him to the opinion that if pure acid is used, this item of expense need not exceed that of any other station charge. If then, as would appear from Mr. Crompton's communication, storage batteries are and can be utilized to assist the dynamos over the heavy load, there ought to be a place for them in central station work, wherever the load diagram will sanction their use.

IS THIS THE FIRST GUN?

THE following appeared as an advertisement in the *Boston Herald* of November 1:

THE EDISON ELECTRIC ILLUMINATING CO. OF BOSTON.

NOTICE TO THE PUBLIC.

The United States Court of Appeals for the Second Circuit, a court of last resort, having rendered a decision fully sustaining the claims of Thomas A. Edison as the original inventor of the incandescent lamp, now in common use, the public in general and all present users of such incandescent lamps in particular, whether burning on isolated plants or on the circuits of any other company, are hereby notified that the above company is the sole owner of all such inventions for the city of Boston, and that the sale or use of the same, without the express consent of said company, is hereby prohibited in said city; and further that any such sale or use, without such consent, will render the person or corporation using the same, liable to actions for damages on behalf of this company.

THE EDISON ELECTRIC ILLUMINATING
COMPANY OF BOSTON,
By JACOB C. ROGERS, President.

Nov. 1, 1892, 3 Head Place, Boston, Mass.

It seems not unlikely that a similar "notice to the public" will shortly appear on the part of Edison licensee companies in other towns at an early date, either as public advertisements or as circular notices to consumers. The Edison Electric Illuminating Company of New York, however, disclaims any immediate intention of serving a notice like that of the Boston company.

The General Electric Company disavows responsibility for the Boston advertisement or for any like announcements by other Edison lighting companies; a trustworthy authority in its behalf stating that each local company does as it likes in that regard, and that the above advertisement should not be taken as implying the adoption of a policy by the General Electric Company. The Boston case is an instance of numerous others, where Edison licensee companies are in competition with other local companies having licenses or contracts with the Thomson-Houston Company. In the present case, however, we do not imagine that the officers of the competing company—the Boston Electric Light Company—are filled with any dismal forebodings of a cessation of its business.

SIEMENS' EXPERIMENTS WITH HIGH-TENSION ALTERNATING CURRENTS.

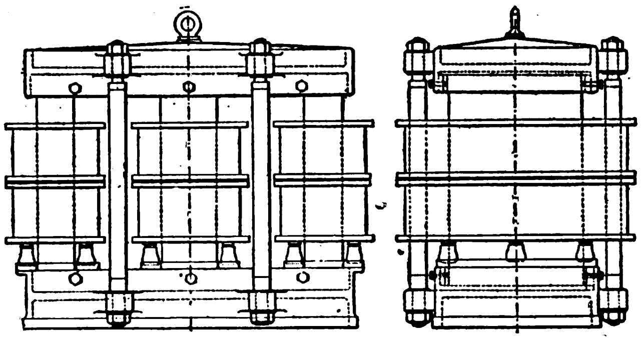
BY

Wm. J. Hammer

Visitors to the Frankfort Electrical Exhibition of 1891 will remember the very interesting experiments shown by Messrs. Siemens & Halske, of Berlin, Germany, with alternating currents of high potential. Two hundred incandescent lamps were seen burning in series; thick sheets of glass were pierced and an arc representing a difference of potential of 20,000 volts was shown. The current employed was produced by a large Siemens alternator, giving an E. M. F. of 2,000 volts which was then transformed up to 20,000 volts.

Messrs. Siemens Bros. & Co., of London, England, in the same year constructed a large transformer capable of giving a pressure of at least 50,000 volts, and during the Naval Exhibition of 1891 repeated many of the experiments made by their confreres in Germany, together with others of a novel and highly interesting character, and subsequently these experiments were shown twice daily at the Crystal Palace Electrical Exhibition of 1892. In the interval Mr. Nikola Tesla had repeated his wonderful experiments with alternating currents of high potential and high frequency before the scientific men of England, at the Royal Institution, and Messrs. Siemens & Co. found it was possible to reproduce some of these phenomena with their apparatus.

The plant used by them at the Crystal Palace consisted of a Siemens W 20 alternator coupled direct to a Willans central valve engine and with the exciter also coupled to the shaft of the alternator; the dynamo had 20 fields and at its normal speed of 400 revolutions per minute gave a frequency of 66.6 complete periods per second. The normal current was 500 amperes, though in the experiments with the "arc" the amperemeter indicated over 600 amperes; the E. M. F. with the full exciting current was 80 volts. A variable resistance in the exciting circuit by means of which the strength of field of the alternator and its E. M. F. could be varied was placed upon the lecture table together with a switch for throwing on or off the exciting circuit which was thus under the control of the experimenter. As an additional precaution switches were inserted in both the primary circuit of the "cable transformer" and the primary of the large transformer.



Figs. 1 and 2.—Siemens High Tension Transformer.

From the alternator the current passed to the primary of a Siemens cable transformer, consisting of a long, flexible, soft iron rope, over which was wound the primary circuit of insulated copper wire; over this was wound the secondary circuit of insulated copper wire and the serving of jute. The windings were put on spirally by means of a cabling machine in the same manner as an ordinary cable is made. The ratio of transformation in the cable transformer was 1 to 30, so that from the secondary of the cable transformer a current of 16 amperes and 2,500 volts was produced. The alternator and cable transformer were placed in the machinery gallery, the latter being suspended in the air and having the appearance of a large steam pipe.

Some 80 yards away, in the Pompeiian Court, the lectures and experiments took place, being in charge of Mr. G. P. Simpson, representing Siemens Bros. & Co. The secondary of the cable transformer was connected to the primary of the large one in the lecture-room by a twin cable insulated with india-rubber. The ratio of transformation in the large transformer was 1 to 20, so that with 2,500 volts in the primary, it was possible to obtain 50,000 volts at the terminals of the secondary. On several occasions the pressure was raised to quite 60,000 volts.

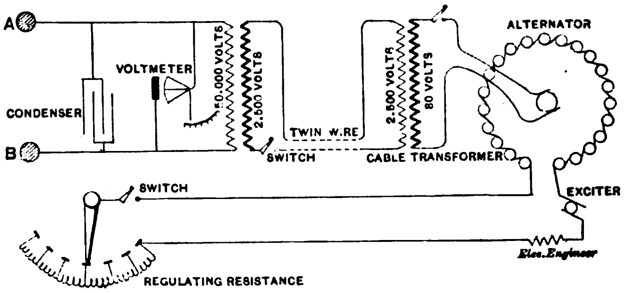


Fig. 3.

The Siemens 130 h. p. transformer is shown in front and end elevation in the accompanying engravings, Figs. 1 and 2.

The magnetic part of the transformer is made throughout of laminated soft iron and comprises three vertical cores, united by horizontal yoke-pieces set into two castings which form the base and cap of the transformer. Each of the castings is furnished with lugs and the whole is firmly held together by bolts passing through them; these bolts are covered with ebonite throughout almost their entire length to prevent any leakage from the windings to earth. In this construction there are two complete magnetic circuits, and as the central core is common to both it has twice the sectional area of either of the others. Each core is surrounded with a primary coil wound directly upon it with a conductor capable of carrying safely 50 amperes, special precautions being taken with respect to insulation.

The secondary winding is wound upon frames which are supported upon porcelain insulators; an air space is left between each primary and the inside of the corresponding secondary giving the latter an air insulation. The ends of the secondary windings on each frame come to terminal blocks mounted on ebonite, so that it is possible to vary the connections of the frames. In the actual experiments all six were connected in series; the extreme terminals were connected to two small brass knobs on ebonite rods standing on the lecture table and to these were joined up the several apparatus used in the experiments. The general arrangement is shown in the accompanying diagram, Fig. 3, where A and B are the two final brass knobs between which the potential difference was produced. Across these knobs there was connected a condenser, which was, however, only used in certain of the experiments, and one of Lord Kelvin's electrostatic voltmeters calibrated for the high potentials used.

In all the experiments, the circuit of the exciter was first closed with all the resistance in; this gave, with the alternator running at full speed, a mean potential difference of 20,000 volts. The resistance was then cut out gradually until the pressure desired for an experiment was secured. For the purpose of exhibiting the arc two carbon rods fitted into brass sockets on top of ebonite rods were placed upon the table, the rods being opposite one another and about 3½ to 4 inches apart; at a pressure of 30,000 volts an arc was formed which could be considerably lengthened. Though carbons were used generally, metal points were found to answer as well.

The arcs shown in the accompanying illustrations, Figs. 4 and 5, were about 3 feet long, each side being 18 inches long. The cuts shown are made from instantaneous photographs taken by the light of the arcs themselves, and I wish to call especial attention to the striations in the flame and to the spiral character of the arc which should throw some light upon the recent discussions[1] in The Electrical Engineer. The spiraling is very clearly shown in these beautiful photographs, and it is exceedingly interesting to note, particularly in Fig. 3, that the flame from the right-hand electrode is a right-hand spiral, while that of the left-hand electrode has a left-hand spiral. The halo shown about the right-hand electrode in Fig. 4 is due merely to a higher temperature of the carbon at that pole; in Fig. 10 they will be seen to be alike.

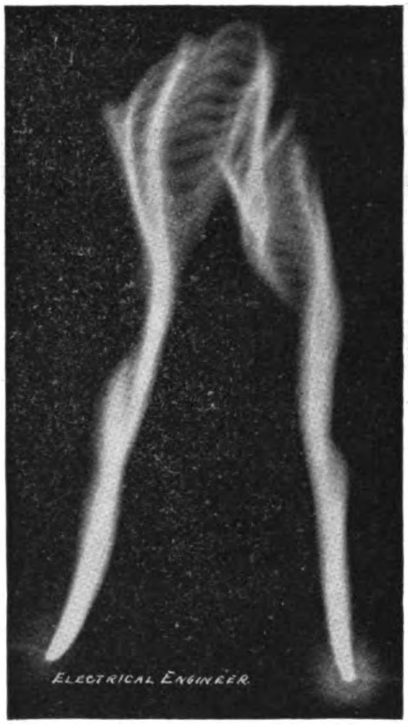


Fig. 4.

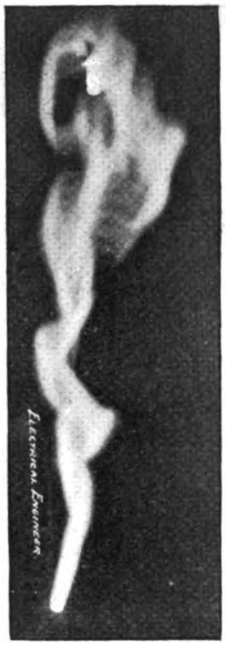


Fig. 7.

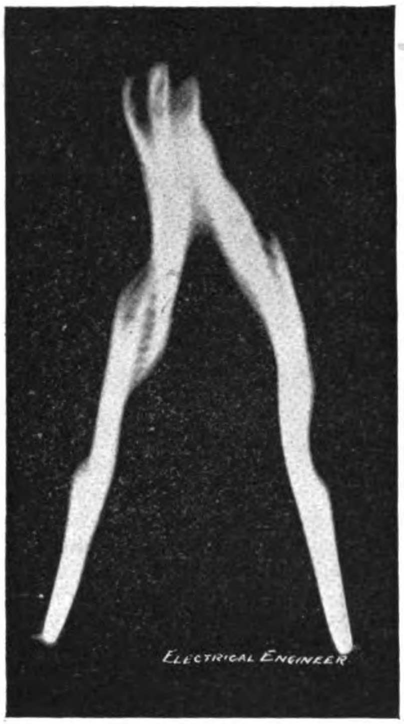


Fig. 5.

In some of the experiments I saw in both Siemens' and Swinburne's experiments at the Crystal Palace the arcs from the two electrodes were of markedly different color, and I heard a number of people explaining that this was due to phenomena of the high-tension currents, which give the arc at each pole a distinctive color. The cause, however, was due solely to the employment of different kinds of carbons as the electrodes. Accompanying the arc one hears a loud humming sound, which, it is interesting to note, is the same in pitch as that given out by the alternator, and probably the striations bear a close relation to the periodicity of the current. The wave-like character of the striations is particularly noticeable in Fig. 4; they were always present. In Figs. 6 and 7 the electrodes are shown placed one above the other, when the arc can be made somewhat longer and the striations sometimes seen more clearly.

When the terminals were connected by some badly conducting substance, such as a long strip of wood, it was easily traversed and soon set on fire. Substances which we have been accustomed to consider good insulators became excellent conductors with a current of such high potential. A plate of slate an inch thick, with an electrode on either side acted like a miniature volcano, some of the silicates being fused and thrown out like lava.

In another interesting experiment a small tank containing water was connected to one terminal, and a metal pan below connected to the other; on opening the top bright flashes of lightning darted through the falling drops, accompanied by snapping sounds and formation of steam, and at times the arc would leap across directly instead of passing through the water. Perhaps the most beautiful effect was produced by interposing a sheet of glass 2 to 4 millimetres thick between the electrodes. The glass was placed upon an insulated support, and at its centre on the back side was placed one terminal ending in a flat brass disc, the other terminal from the transformer which carried a metal rod being placed opposite on the front side of the glass. The rod was arranged to carry a conical point, a sphere, or disc, as desired. The nature of the discharge did not vary very greatly with changes in the form of the upper electrode; the most striking effects were, however, produced by a disc back and front. These are shown in

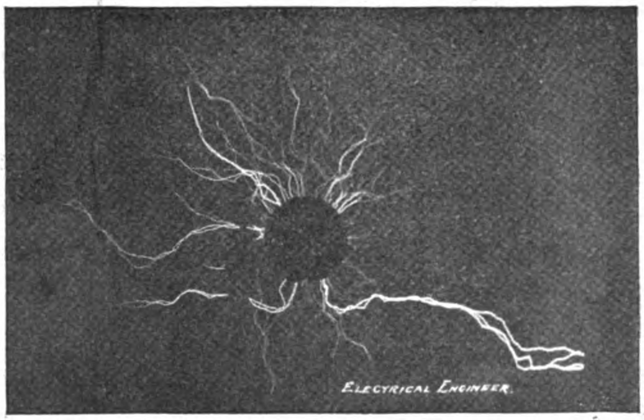


Fig. 8.

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[1] See The Electrical Engineer, July 20 and Sept. 14, 1892.

Figs. 8 and 9, also reproduced from instantaneous photographs. In the former an E. M. F. of 35,000 volts was used; both surfaces of the glass were covered with innumerable purplish blue lines.

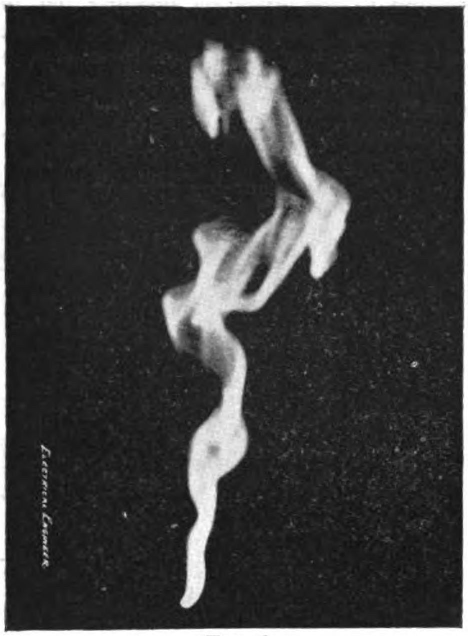

FIG. 6.

It is interesting to note, that while in the photograph these appear as single threads radiating from the electrode, when viewed by the eye, owing to the persistence of vision, these threads seem mixed up in a most intricate network, changing with marvelous rapidity. Upon raising the pressure still higher, white flashes begin to pass completely around the glass from one electrode to the other accompanied by a loud report. In Fig. 8 one such flash is shown. In Fig. 9 the flashes in great number are shown passing around the glass; they are blinding, and so loud as to be unpleasant to the ear. This photograph was taken when the E. M. F. had reached 45,000 volts; the shadow just below that of the brass disc is caused by the ebonite rod. As the plate is of glass the flashes on both sides are visible, and at the lower edge is shown one loop or flash dying out.

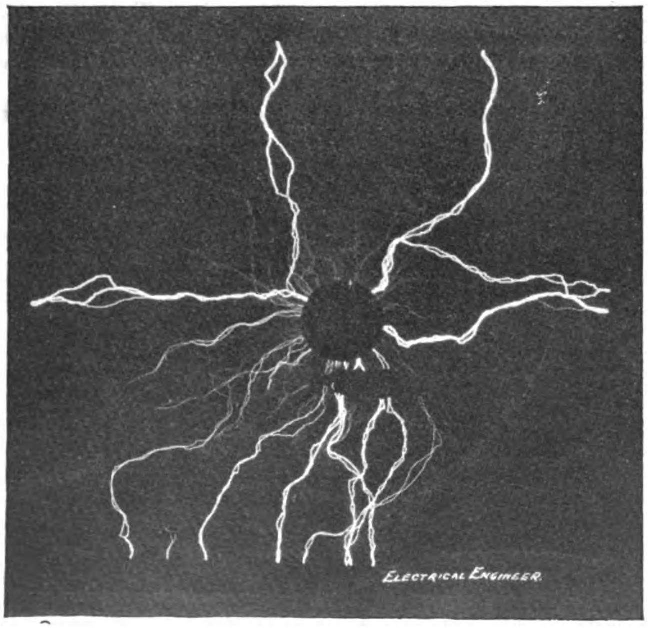

FIG. 9.

After 45,000 to 50,000 volts have been on for periods depending upon the thickness of the glass, the insulation gives way, and the glass, which has been growing constantly hotter and hotter, shows a small hole opposite the periphery of the disc electrode; but upon shutting off the current it was always found that the molten glass had closed the hole up again. Sometimes a circular crack would start from the hole and small cracks would radiate therefrom, breaking the glass into a thousand pieces. Sheets of ebonite, slabs of paraffine wax and marble behaved in a manner similar to the glass.

A most practical demonstration of the high E. M. F. atattained was shown by sending the current from the secondary directly through a bank of 500 16 c. p. incandescent lamps joined in one series; each lamp required 105 volts and at full candle power, as shown, the E. M. F. must have been 52,500 volts. The current required for the lamps used was 0.58 ampere, so the total electrical energy represented in the bank was 40 h. p. The transformer had, however, a capacity for four times this load, viz., two amperes at 50,000 volts. The breaking of one or even a dozen lamps did not affect the rest, as the current arced across the terminals. Comment was caused by the constant vibration of some of the filaments but whether due to the current or to a mechanical cause was not demonstrated. In the above-mentioned experiments considerable power was employed and the circuit was in all cases completed.

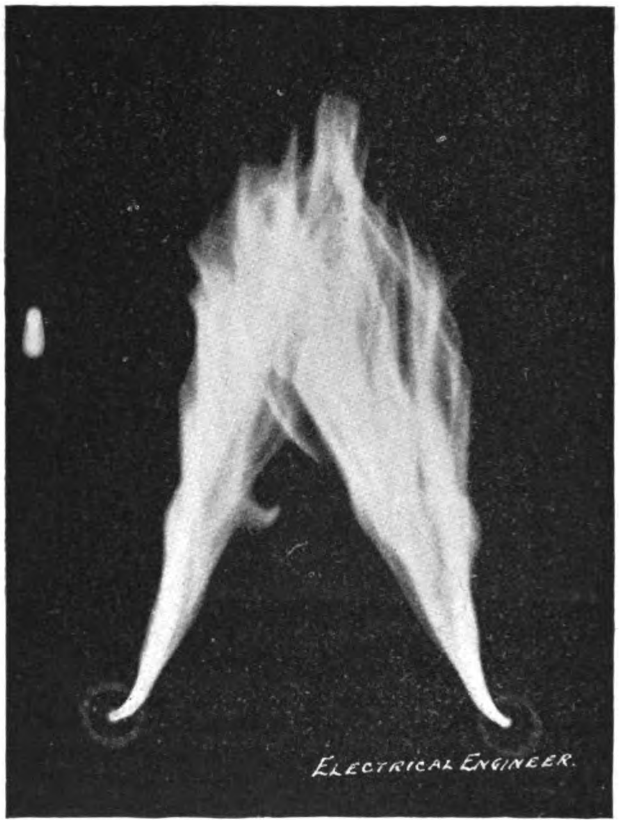

FIG. 10.

Further experiments were conducted by Messrs. Siemens' representative, Mr. Simpson seeking to reproduce some of the results Mr. Tesla obtained, when there was no complete circuit. In these experiments only 66 complete periods per second were employed and a potential difference of 50,000 volts. Two copper wires, either bare or insulated with cotton, were stretched parallel to each other in one horizontal plane about eight inches apart between four ebonite rods, the wires being 10 to 12 feet long. The wires were connected direct to the terminals of the secondary, no means being used to increase the electrical oscillations. When the circuit was closed the wires became luminous in the dark, not throughout their length, as Tesla showed, but as if beads were strung on the wires; these were probably the nodal points referred to by Tesla. Frequently the two wires would vibrate bodily, like a harp string, such vibration being set up by the electrical oscillations and not by mechanical means; perhaps the lamp filaments, if the degree of vacuum and delicacy of the filament are suitable, vibrate from the same cause.

Two large rings of wire three feet in diameter showed similar phenomena of nodal points. These electrical oscillations passed through the air a considerable distance, as shown by the illumination of a "Tesla tube" that is, a vacuum tube without electrodes 3 feet long and exhausted to about one millionth of an atmosphere. The tube, when placed near the wires became filled with a bluish glow and when a sheet of tin was attached to one terminal, the other being insulated, the Tesla tube glowed anywhere in the neighborhood of the metal sheet. In dry weather the glow would continue at a distance of 5 or 6 feet; in a moist atmosphere the distance was from 2 to 3 feet and during the prolonged and severe thunderstorm of June 28, 1892, the tube would not glow in any position.

One other Tesla effect shown at a frequency of only 66 was holding a tube in the left hand at such a distance from the terminals that no glow was visible and on touching one terminal with the right hand the tube became filled with the usual glow, the electrical oscillations being transmitted through the experimenter's body; the only effects appreciable were a slight shock in the right arm and a distinct rise in the temperature of the whole body.

In conclusion I wish to call attention to the photograph shown in Fig. 10. This was taken by Messrs. Swinburne & Co., of London, who have been conducting experiments recently in currents of high potential and high frequency. They also gave exhibitions at the Crystal Palace Electrical Exhibition of 1892, following the same general lines as those of Messrs. Siemens & Co., but employing transformers immersed in oil and producing, so they claimed, an E. M. F. of 150,000 volts, the photograph shown represents an arc produced (?) at that potential. In the absence of any testing instruments capable of indicating over 75,000 volts or even a bank of lamps which would perhaps be even more reliable evidence, the potential attained can only be surmised. Their experiments were however most interesting.

INSULATED ELECTRIC CONDUCTORS.[1]—XIII

BY

James Bowstead Williams M.E.

In the last article a brief description only of braiders and the manufacture of painted wires was given, but as this class of wires forms a considerable proportion of the insulated conductors now in use, and their manufacture deserves more care and attention than it usually receives—for if weatherproof wires were better insulated there would not be *quite* so many accidents of one kind or another when the ordinary weatherpoof wires carrying high tension currents come in contact with grounded bodies—the writer proposes to enter into the details of the production of such wires. In addition to the painted wires, there will be added some examples of wires having dielectrics formed of other materials besides fibre and paint, and which may also be properly classed among weatherproof wires.

Before entering into the details of manufacture it will be well to consider the substances which constitute the dielectrics of the wires, fibre and paints.

The fibrous material may, for convenience of description, be considered as forming the framework of the dielectric. It also acts as an absorbent of the insulating compositions, and retains them in contact with, and in position upon, the wire. Paint, as well as other material which can readily be applied while in a liquid state, without some means for securing it to the wire would soon become detached and useless, even though many layers or coats had been applied one upon the other, and each allowed to harden before the next was applied. The fibre should be strong, soft, and flexible, and the yarn or thread formed of it be of uniform thickness. It should be free from all gummy and other foreign matters, and absorb liquids readily, so that all of the interstices of the fibrous covering may be completely filled; and the less fuzz projecting from the separate layers of braid, the better for the insulation. Good, fresh, clean cotton combines these qualities to a high degree, and is probably the best and cheapest fibre now at hand. Silk would be a most excellent fibre for the layer next the wire, but its high cost prohibits its use. Jute fibre is too coarse and brittle for braided layers, and will not lie close. Cotton, silk and jute are very hygroscopic, and great care is required to keep them dry during the manufacture of dielectrics. Insulating paints differ from common paints in many respects, both in their application and composition. In the following tabular statement will be shown the chief points of similiarity and difference; and these will be followed by explanatory remarks.

Insulating Paints.	*Common Paints.*
1. Must be flexible.	1. Need not be flexible.
2. Should harden quickly.	2. Should harden quickly.
3. Must contain little or no lead or other conducting material.	3. May contain a large amount of such material without injury.
4. Should contain little or no volatile solvents.	4. Usually contain such solvents.
5. Are applied upon rough or uneven surfaces.	5. Are applied upon smooth and prepared surfaces.
6. Do not need a gloss or finish.	6. A gloss is nearly always required to improve their appearance.
7. But one application should be required for each layer.	7. Two or more coats are usually required to form a covering.
8. May contain dryers.	8. Usually do contain them.
9. A soft and tough finish desirable.	9. A hard finish desirable.
10 Must be a *chemical* compound, and contain no precipitates.	10. Often a mechanical mixture only.
11. Must contain no water in the solvent.	11. Water often forms a portion of the solvent.

It is to be understood that the statements just made refer to the best kinds of insulating paints and not to *protecting* paints.

The explanatory remarks will be numbered to correspond with the statements in the table.

Remark 1.—No paint should be used for insulating wires which will not form a layer more or less flexible, when dry. In practice we often find paints which are hard and brittle. Such paints, while they may possess good insulating properties at first, soon got full of cracks if the wires are bent, or if they are subjected to changes of temperature. Far better have an insulating covering into which a tie or binding wire may sink a little than a rigid one which will get full of cracks and *therefore* full of moisture.

Remark 2.—While it is not absolutely necessary that paints should dry rapidly, it is desirable that they should do so; and, in all cases, painted wires should be kept in a warm dry place until the coverings are dry. No painted covering should be allowed to dry after the wires are strung on poles. The writer spent considerable time in the manufacture of painted wires, and found that, in every case, when paints not thoroughly dry are exposed to the atmosphere *moisture goes in as solvent goes out.* The reason for this is that as the solvent evaporates, minute air spaces are formed in the covering; and as there is no way by which these spaces can be filled with insulating material after the wires are suspended, moisture necessarily enters them by capillary attraction. Unfortunately, for electricians, the most rapidly drying paints are not the best insulating paints.

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ELECTRIC RAILWAY DEPARTMENT.

THE RESISTANCE OF RETURN CIRCUITS IN ELECTRIC STREET RAILWAY PRACTICE.

BY

R. C. Warner

In general electric street railway practice, and more especially where cars are operated at considerable distances from the power station, the securing of a circuit of the lowest possible resistance consistent with economical construction becomes a matter of particular importance. For the overhead or positive side of the circuit the problem is a comparatively simple one, it being merely a question to what extent increased outlay for feeders is compensated for by increased efficiency of transmission. The return circuit through the rails and earth presents, however, an entirely different set of conditions, varying with the location and the seasons and dependent upon the character of the soil, nature of the construction, cleanliness of tracks, etc. So far as the constructing engineer is concerned, the problem is mainly one of efficient bonding. The question, then, is, What *is* "efficient bonding," and how may it be most economically secured?

This question has received a variety of answers from engineers, but accurate data as to the relative value of the various methods employed is extremely scarce. It was with a view of securing, if possible, some definite information on this subject that the writer jointly with Mr. G. L. Thayer, undertook, at the instance of a well-known firm of engineers, a series of tests, the results of which are here given.

Portions of the tracks in use in Utica, Rochester and Buffalo were included in the tests, the object being to determine the resistance in ohms of known lengths of track representing different methods of construction as regards bonding, etc. The method first tried for determining this resistance was that of the Wheatstone bridge. A portable bridge and battery were taken to Utica, and during the night, after the machines had shut down, the feeders were cut out, the trolley wire and tracks connected at one point and the bridge put in at a known distance, the length of track and trolley wire forming one arm. The idea was to determine the resistance of this circuit in the ordinary manner and then deduct the known resistance of the length of trolley wire to find that of the tracks. Owing, however, to a counter E. M. F., due to connections and grounds, it was found impossible to balance the bridge, and this plan had to be abandoned.

A fall of potential method was next tried with better success and was used in the subsequent tests. The Utica power station is located at some distance from the lines operated near the tracks of the R. & W. R. R. Advantage is taken of the proximity of these tracks to secure a return circuit from one portion of the road down town, the machines being connected direct to the tracks by No. 0 copper wire. The top wire of a barb wire fence running parallel with the railroad was connected to the rails as a potential wire at a known distance from the station, and a Weston voltmeter was used to determine the drop through this length of track, the current being read from a Weston ammeter placed between the machines and the track.

The use of a cut-out feeder as a potential wire, which had been intended at Rochester and Buffalo, was prevented by the fact that these roads operate all night with but a short stop, and it became necessary to run a special line of iron wire for each piece of track tested. The extreme end of a line was tested in each case, where the cars run at long enough intervals to leave the track clear for some minutes at a time. The iron potential wire was connected to the track by filing out a rail joint and wedging the wire against the end of the rail. A No. 5 copper wire bound to a fishing pole was used to take current from the trolley wire, and a convenient adjustable resistance was made by fastening one copper terminal plate on the inside of a wooden bucket filled with water, and suspending another from a slide on the top of the bucket. The capacity of the resistance was increased as desired by the use of salt. A Weston voltmeter of high resistance was used in every case, except the first day on Park avenue, Rochester, when a Weston instrument of but 597 ohms resistance was used. A correction must, therefore, be made in this case, for the resistance of the potential wire, as follows:

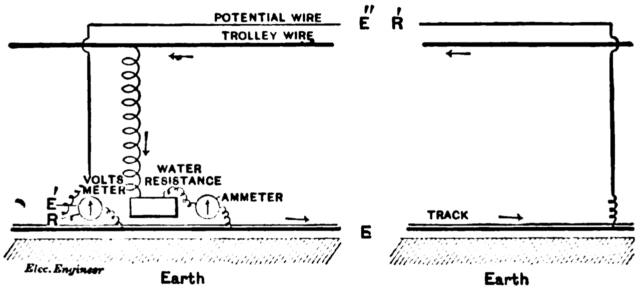


Diagram of Testing Method.

Let E = drop through the 3,000 feet of track tested;
" E' = " " " voltmeter;
" E'' = " " iron potential wire;
" R = resistance of voltmeter = 597 ohms;
" R' = " potential wire = 110 ohms;
" C = current flowing through voltmeter.

$$E = E' + E''; \; C = \frac{E'}{R}; \; E'' = CR' = E'\left(\frac{110}{597}\right)$$

$$E = E' + E'\left(\frac{110}{597}\right) = E'\left(1 + \frac{110}{597}\right) = E' \times 1.1845.$$

The observed drop then, multiplied by this constant gives the actual drop in the track.

In the case of the Lake Avenue Line, Rochester, a nearly constant counter E. M. F. was found. The main circuit was, therefore, broken, and readings of the counter E. M. F. taken before and after each regular reading, and the amount of this counter E. M. F., added to the observed E. M. F., gave the actual drop in the rails due to current flowing.

The tracks tested were as follows:

A.

Location: Utica, near power station. 690 feet single track built of 60 lb. T rails, joined by angle bars and laid on sawed ties. No bonding. Condition of tracks, June 8, dry and hot at rail joints. Time, 10 a. m.

B.

Location: Park Avenue Line, Rochester, from car barns West. 3,000 feet double track, built of flat rails, 60 lbs. per yard, set on chairs. Bonded with one No. 3 galvanized iron wire, or two No. 6 galvanized iron wires "and other wire on hand at the time." Wire soldered and riveted to rails. No continuous wire. Rails cross-bonded with iron wire every 200 feet. Tracks cross-bonded only by the switches at and near barns, which, apparently, answered the purpose of cross-bonds very well, as the fall of potential was the same through both tracks. Length of time in use, two months. Condition of tracks, June 28, dry; June 30, very wet, the test being made during a heavy rain. Time, 11 a. m.

C.

Location: Lake avenue, Rochester, from city limits south. 3,270 feet single track, built of 40 pound T-rails, laid on sawed ties, no chairs. Bonded with one No. 3 copper wire riveted to rails. Continuous wire No. 3 copper is run inside each rail and a soldered strap connection made with each bond wire; rails cross-bonded every 200 feet. The tracks are on opposite sides of the street inside the curb, some 60 feet apart, and are not connected in any manner near this point. The track tested on one side of street may, therefore, be safely called single track. Length of time in use, two years. Condition of track June 30, wet. Time, 4 a. m.

TRACK A.

690 feet single track. *No bonds*, dry.

No.	*C.*	*E.*	*R.*
1	102	22	.216
2	97	21	.216
3	40	10.5	.261
4	60	15	.250
5	65	15	.231
6	80	18	.225
7	95	21	.221
8	85	19	.224
9	70	15	.215
10	90	19	.211
11	100	20	.200
12	84	18	.214
13	98	19	.194
14	110	20	.181
15	90	19	.211
16	100	20	.200
17	140	25	.178
18	70	15	.214
19	120	21	.175
20	140	25	.179
21	100	19	.190
22	150	25	.166
23	130	21	.161
24	190	30	.158
25	124	20	.161
26	160	26.5	.165

Mean = .2006 ohm

Resistance = .2907 ohm per 1,000 feet.
" = 1.5349 " " mile single track.
" = .7675 " " " double track.

TRACK B.

3,000 feet double track—bonded—cross-connected. *No continuous wire.*

First day—Dry.					Second day—Wet.			
No.	*C.*	*E.*		*R.*	No.	*C.*	*E.*	*R.*
		obs'd	corrected.					
1	38	1.5	1.78	.0470	1	34	1.4	.0412
2	44	1.66	1.97	.0447	2	50	2.2	.0440
3	45	1.66	1.97	.0438	3	59	2.3	.0390
4	65	2.5	2.96	.0455	4	64	2.3	.0360
5	57	1.9	2.25	.0395	5	73	3.0	.0411
6	64	2.5	2.96	.0462	6	71	3.0	.0422
7	70	2.8	3.32	.0475	7	80	3.2	.0400
8	64	2.5	2.98	.0465	8	70	3.0	.0429
9	72	3.1	3.68	.0511	9	40	1.8	.0450
10	63	2.5	2.96	.0470	10	47	2.0	.0426
11	62	2.4	2.84	.0458	11	57	2.3	.0404
12	55	2.1	2.49	.0453	12	55	2.1	.0382
13	58	2.1	2.49	.0429				
14	60	2.12	2.52	.0420				

Mean = .0412 ohm

Mean = .0453 ohm

Resist. = .0151 ohm per 1,000 ft.
" = .0797 " " mile double track.

Resist. = .0134 ohm per 1,000 ft.
" = .0717 " " mile double track.

D.

Location: End of Tonawanda street, Buffalo. 4,110 feet double track, built of 60 pound groove rails set on chairs. Bonded with one No. 3 copper wire, soldered and riveted to rails. Continuous wire No. 3 copper is run inside each rail, and a soldered strap connection made with each bond wire. Rails are cross-bonded every 60 feet; tracks cross-bonded every 90 feet. Length of time in operation, about one year. Condition of tracks July 2, dry. Time, 1 p. m.

E.

Location: Line running from Buffalo to Tonawanda. Connects with Tonawanda street line at city limits. 3,810 feet single track, built of 45 pound T-rails laid on sawed ties. Bonded with two No. 4 galvanized iron wires, soldered and riveted to rails; no continuous wire. Rails are cross-bonded every 60 feet. Length of time in operation, about one year. Condition of tracks July 2, dry. Time 3 p. m. No very heavy currents could be used with this track owing to the limited capacity of the station, the cars being operated by one 120 K. W. machine.

The accompanying tables give the results of the observations.

TRACK C.

3,270 feet single track. Bonded—*Continuous wire*—Wet.

No.	*C.*	*E.*			*R.*
		obs'd	counter.	total.	
1	46	.3	.9	1.2	.0261
2	32	.0	.8	.8	.0250
3	38	.0	.9	.9	.0237
4	41	.2	.8	1.0	.0244
5	32	.0	.8	.8	.0250
6	36	.1	.8	.9	.0250
7	75	1.1	.8	1.9	0254
8	82	1.2	.8	2.0	.0244
9	68	1.0	.75	1.75	.0257
10	71	1.0	.8	1.8	.0253
11	65	.8	.8	1.6	.0246
12	20	.2	.8	.6	.0300
13	28	.1	.9	.8	.0286
14	42	.0	.9	.9	.0214
15	45	.2	.8	1.0	.0222
16	49	.4	.8	1.2	.0245
17	58	.8	.8	1.6	.0276
18	58	.8	.8	1.6	.0276

Mean = .0256 ohm

Resistance = .007838 ohm per 1,000 feet.
" = .0413 " " mile single track.
" = .0207 " " " double track.

TRACK D.

410 feet double track. Bonded—*Continuous wire.*

No.	*C.*	*E.*	*R.*
1	64	1.2	.0188
2	63	1.2	.0191
3	80	1.7	.0212
4	90	1.8	.0200
5	93	1.8	.0194
6	100	1.9	.0190
7	86	1.6	.0186
8	96	1.9	.0198
9	97	1.9	.0196
10	99	1.9	.0192
11	57	1.1	.0193
12	54	1.1	.0204
13	55	1.1	.0200
14	55	1.1	.0200
15	61	1.1	.0180
16	62	1.15	.0185
17	68	1.2	.0200
18	66	1.2	.0182
19	66	1.2	.0182
20	73	1.3	.0178
21	75	1.3	.0173
22	32	.7	.0219
23	27	.5	.0185
24	29	.6	.0207
25	27	.6	.0222
26	37	.8	.0216
27	43	1.0	.0233
28	44	1.0	.0228
29	47	1.0	.0213
30	53	1.05	.0198

Mean = .01982 ohm

Resistance = .004815 ohm per 1,000 feet.
" = .0254 " " mile double track.

The resistance has in each case been reduced to ohms per mile double track, the assumption being made that the resistance of two tracks in parallel will be half that of either one, which is very well borne out by a comparison of the results obtained. A consideration of the conditions of the different pieces of track tested affords an explanation of the slight differences of resistance for tracks of similar construction. Track "B" shows a resistance of .0797 ohm when dry, as compared with .0577 ohm for track "E," the method of construction being similar with the exception that "B" was bonded with one No. 3 wire, two No. 6 wires and "other wire on hand at the time," while the Tonawanda line, "E," was bonded throughout with two No. 4 wires, the wire used in both cases being galvanized iron. The difference in favor of the more thorough bonding is over 27 per cent. It will be noticed that the more lightly bonded track has a 60 lb. rail, as compared with a 45 lb. rail for the track of lower resistance. The construction of tracks "C" and "D" in Rochester and Buffalo respectively, is very similar and the resistance proves to be less in the case of the former, which was very wet when tested. It happens in this case again that the lighter rail is in the track of lower resistance. Comparison of the results for the two days on Park avenue track "B," shows that the resistance is some 10 per cent. less when the tracks and earth are wet.

TRACK E.

3810 Feet. Single Track. Bonded. *No Continuous Wire.*

No.	*C.*	*E.*	*R.*	No.	*C.*	*E.*	*R.*
1	15	1.1	.0735	13	25	1.9	.0760
2	15	1.0	.0669	14	25	2.1	.0840
3	15	1.1	.0735	15	26	2.1	.0809
4	17	1.6	.0942	16	29	2.0	.0609
5	19	1.9	.1000	17	32	3.0	.0940
6	18.5	1.7	.0920	18	35	2.8	.0890
7	20	2.0	.1000	19	31	2.7	.0940
8	21	1.9	.0950	20	33	2.8	.0850
9	20	1.6	.0800	21	34	2.6	.0765
10	21	1.7	.0810	22	34	2.6	.0765
11	24	2.1	.0875	23	33	2.7	.0817
12	25	1.9	.0160	24	34	2.7	.0795
						Mean =	.0832 Ohms.

Resistance = .0218 ohms pr. 1000
" " .1154 " " miles single track.
" " .0577 " " " double "

Taking results representative of the three general cases for comparison we have:

"A." Resistance of unbonded track (double) per mile = ...	.7675 ohm.
"E." Resistance of double track bonded and cross-connected with *iron* wire *non-continous* = ...	.0577 ohm.
Resistance being only 7.5 per cent. of A.	
"D." Resistance double track bonded and cross-connected with *copper* wire, *continuous wire*, = ...	.0254 ohm.
Being a reduction of 56 per cent. from "E," due to *copper* and continuous wire.	

That weight of rail does not enter appreciably as a factor in the resistance of the return circuit is shown conclusively by a computation of the resistance due to bonds alone. In case "D," taking the average length of a bond as three feet, 176 bonds per mile, there is, roughly, 530 feet of bond wire per mile for each rail: In one mile of double track then, there are eight No. 3 wires in parallel, four of them 5,280 feet in length, and four 530 feet, the resistance of which proves to be .0236 ohm.

Case "D."—Total resistance of tracks, *tested*	.0254	ohm.
Resistance of bonds and continuous wire *alone, computed*.....	.0236	"
Difference....................	.0018	"

Similarly for case "E."

Total resistance of tracks, *tested*...........	.0577	ohm.
Resistance of bonds *alone, computed*......	.0556	"
Difference.....................	.0021	"

From this it will be seen that it is possible to compute within a few per cent. the actual resistance of the return circuit with *any* proposed method of bonding, etc., as readily as may be done for the overhead construction.

That the use of a continuous wire with each rail in addition to bonds, commonly recommended as "best construction," is not only much more expensive but also considerably less efficient than thorough bonding alone, may be readily proven. Taking for instance case "D" above, suppose that instead of *one* bond of No. 3 copper at each rail joint with continuous wire inside rail, there be used *two* bonds of No. 3 copper *without* continuous wire. Assuming as before an average length of 3 feet per bond, there would be for double track construction per mile eight No. 3 wires 530 feet long in parallel, with a resistance of .013 ohm. Allowing for resistance of rails and connections .002 ohm, the total resistance of one mile double track = .015 ohm. The resistance with continuous wire instead of additional bond (see "D") was .0254 ohm, or .0104 ohm *more* than in the case assumed. The length of No. 3 wire required per mile double track for construction "D" would be

Continuous wire............................	21,120	feet.
Bonds..	2,120	"
Cross-bonds.....	1,240	"
Total........................	24,480	"

or 3,898 pounds of copper, at 14¼ cents per pound, costing $555.47; while for the assumed construction it would be

Bonds..	4,240	feet.
Cross-bonds..........	1,240	"
Total.............	5,480	"

or 872 pounds, costing $124.26.

The change amounts in substance to cutting out four pieces of wire 4,750 feet in length and substituting for them rail of practically unlimited carrying capacity effecting a reduction in resistance of 41 per cent. and a saving in cost of copper for the return circuit of over 75 per cent. The possible saving would of course be considerably greater in the case of roads using No. 1 or No. 0 continuous wires, and would seem to be well worthy the consideration of street railway managers and constructing engineers.

ELECTRIC RAILWAY WORK AT TROY, N. Y.

THE consolidation of the Troy & Lansingburgh and Troy City railways, can only be effected by a lease, as the purchase of the *entire* stock of the Troy & Lansingburgh Railroad is barred, except under a tedious and expensive legal proceeding. Some 140 shares of the stock are still held by estates and persons absent from the country, who cannot be reached at present. In the case of the estates in progress of settlement and held by administrators in trust for minor heirs, nothing in the matter of purchase can be effected, as it would require months to pass the judicial procedures necessary to obtain the stock in question. Hence the shortest way out of the difficulty is said to be a lease of one road to the other, guaranteeing a certain dividend to the stockholders, and as the new corporation holds nearly all the stock of both companies it will be readily seen that any dividends derived from the leasing of the various roads, under the present control of the Troy & Lansingburgh directorate, will be divided among the stockholders in the new corporation, less the amount due the heirs and holders of old stock on the earnings of the particular branch of road so leased.

The Troy City Road is progressing slowly with the River street power house, having at present but one boiler set in position, while the heavy stones for the engine and dynamo foundations are on the ground. The house is at present used only as a car storehouse, power being amply supplied from the Division street power house of the Troy and Lansingburgh road.

A POSTAL STREET CAR SERVICE FOR ST. LOUIS.

FOR two years, Postmaster Harlow has been endeavoring to utilize the street cars in the delivery of mails, and his efforts have at length proved successful. The St. Louis and Suburban Line will run a regular mail car from its eastern terminus to Cabanne. The car is fitted up with mail racks and is constructed especially for the service required. It will deliver mail at the substations on its line. The system will be extended to other street railway lines.

RAILWAY FENDERS ON THE WEST END RAILWAY, BOSTON.

Acting at the request of the Massachusetts Railroad Commission, President Henry M. Whitney, of the West End Street Railway, appointed a commission to recommend a form of fender for use on the cars of his company. The commission consisted of Messrs. Thos. C. Clarke, C. E. A. Bartlett and Geo. F. Swain.

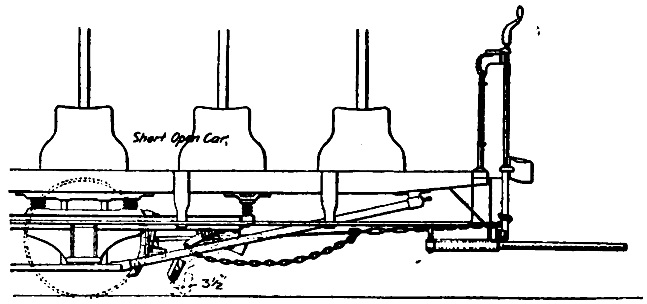
The commission in their report just published state that no less than 211 fenders were presented for examination by plan, model or description. It was found upon examination that all the fenders which were brought to the attention of their company could be divided into three classes, viz.:

A. Buffers which soften the blow given by the car to the person, and pick him up in a net. B Platforms which project beyond the dashboard of the car, and upon which a person could leap, or, standing up, could be caught and carried along. C. Fenders which are placed below the car platform, and whose object is to push along a body lying down upon the tracks, and prevent it from getting under the wheels.

After careful examination of all the devices, it was decided to make experiment with certain ones upon dolls or dummies made, as nearly as possible, of the size, shape and weight of a man, a woman and a child; 43 fenders were, therefore, constructed of full size, and attached to the cars of the West End Company, and experimented with.

Several different kinds of fenders were also attached to cars in regular service; and the commission examined written evidence upon the use of fenders in Kansas City, Cleveland, Rochester and other places.

After more than a year's experimenting with the various devices submitted the commission recommends the adoption of the "Cleveland" platform and buffer, the invention of Mr. Thos. L. Johnson, president of the Cleveland City Railway Company, in combination with a movable fender invented by Mr. L. J. Hirt, master mechanic of the West End Street Railway. Both arrangements are shown in the accompanying engraving.



Car with Cleveland Platform and Buffer and Hirt Fender.

The Cleveland platform and buffer has been modified by the officers of the West End Company, to enable it to be slid under the cars, or under the rear of any car, when it is not in use.

In the type of fender submitted by Mr. Hirt the turning of the brake handle first applies the brake, and then lowers the fender down to the track. The action may be made so quick, however, that the two movements appear nearly simultaneous. This device has no parts that would seem liable to get out of order. It has shown itself, under test, at least as efficient as any other fender. Its operation insures the maximum safety to a body lying on the track, and it imposes no additional duty or responsibility on the motorman in addition to those he now has.

Preparations are being made for equipping all the West End cars with the above described fenders.

STREET RAILWAY BLOCK SIGNAL SYSTEM AT ROCHESTER, PA.

An electric block system is in use on the Rochester, Pa., Electric Railway, a single track line about four miles in length. At each passing siding is located a single box containing two groups of lamps, each group consisting of three lamps of 16 c. p. each. These lamps are wired in series of six, the three lamps in the upper half of one box being connected directly with the three lamps in the lower half of the next box about 4,000 feet away. They are supplied with current from the trolley wire, by a No. 21 galvanized iron wire, in order to get the resistance necessary. Each box is equipped with two three-way switches for turning off the lights, or turning them on as the car enters the section. The cars going in one direction are blocked by lamps burning in the upper half of the boxes, and in the other direction by lamps burning in the lower half of the boxes.

ELECTRIC RAILWAY LITIGATION.

A circular issued by the General Electric Co. gives a list of electric railway suits in which it is interested and which are likely to be pushed. The suits enumerated are as follows:

1.

Thomson-Houston Electric Co.
vs.
Elmira and Horseheads Railway Co.
Circuit Court of the United States for the Northern District of New York.

Subject: *Under Running Trolley.*

Patents.

No 403,801—C. J. Van Depoele, May 20, 1889, for *Cross-Suspension for Trolley Wire.*
No. 424,880—C. J. Van Depoele, March 25, 1890, for *Cross-Suspension for Trolley Wire with Cross-Wires Under Tension.*
No. 424,695—C. J. Van Depoele, April 1, 1890, for *Trailing Switch, Switch Plate with Ribs, Trolley Wheel Fender.*
No. 467,448—C. J. Van Depoele, January 19, 1892, for *Broad Patent for Under Running Upward Pressing Contact Trolley.*

2.

Sprague Electric Railway and Motor Co.
vs.
Fitchburg and Leominster St. Ry. Co.
Circuit Court of the United States for the District of Massachusetts.

Subject: *Electric Motor Trucks.*

Patents.

No. 324,892—F. J. Sprague, August 25, 1885, for *Motor Sleeved on Axle at one end and Spring Supported at the other end.*
No. 406,600—F. J. Sprague, July 9, 1889, for *Motor Sleeved on Axle at two points.*
No. 424,436—F. J. Sprague, March 25, 1890, for *Individual Motors for Separate Axles.*

3.

Sprague Electric Railway and Motor Co.
vs.
Fitchburg and Leominster St. Ry. Co.
Circuit Court of the United States for the District of Massachusetts.

Subject: *Duplicate Controller Switches at opposite ends of Car, Reversing Motor and Regulating Resistance of Motor Circuit.*

Patent.

No. 481,739—F. J. Sprague, August 30, 1892.

4.

Thomson-Houston Electric Co.
vs.
Wakefield and Stoneham Railway Co., Chas. Woodward and M. E. Clemens.
Circuit Court of the United States for the District of Massachusetts.

Subject: *Trolley having Constant Pressure with Pole at Varying Angles.*

Patent.

No. 394,087—C. J. Van Depoele, December 4, 1888.

5.

The Thomson-Houston Electric Co.
vs.
Pittsfield Elec. St. Ry. Co., *et al.*
Circuit Court of the United States for the District of Massachusetts.

Subject: *Arched Suspenders for Electric Railway Trolley Wires.*

Patents.

No. 393,317—C. J. Van Depoele, Nov. 20, 1888.
No. 396,311—C. J. Van Depoele, Jan. 15, 1889.
No. 396,312—C. J. Van Depoele, Jan. 15, 1889.

6.

The Thomson-Houston Electric Co.
vs.
Pittsfield Electric Street Ry. Co., *et al.*
Circuit Court of the United States for the District of Massachusetts.

Subject: *Lightning Arrester.*

Patent.

No. 321,464—Elihu Thomson, July 7, 1885.

7.

Edison Electric Light Co.
vs.
Glens Falls, Sandy Hill and Fort Edward Street Ry. Co., *et al.*
Circuit Court of the United States for the Northern District of New York.

Subject: *Constant Potential Regulation by a Compound Dynamo.*

Patent.

No. 264,668—T. A. Edison, Sept. 19, 1882.

8.

Thomson-Houston Electric Co.
vs.
Elec. Merchandise Co., W. R. Mason and A. H. Englund.
Circuit Court of the United States for the Northern District of Illinois.

Subject: *Overhead Switches.*

Patents.

No. 393,278—C. J. Van Depoele, Nov. 20, 1888, for *Switch and Crossing.*
No. 396,313—C. J. Van Depoele, January 15, 1889, for *Adjustable Switch and Crossing.*

9.

Thomson-Houston Electric Co.
vs.
Elec. Merchandise Co., W. R. Mason and A. H. Englund.
Circuit Court of the Unites States for the Northern District of Illinois.

Subject: *Arched Suspender and Pull-off for Trolley Wires.*

Patents.

No. 393,317—C. J. Van Depoele, Nov. 20, 1888, for *Arched Insulator Holder.*
No. 396,311—C. J. Van Depoele, Jan. 15, 1889, for *Single Arched Insulator Holder.*
No. 396,312—C. J. Van Depoele, Jan. 15, 1889, for *Arched Insulator Holder with Adjustable Ear.*

PROTESTS IN BUFFALO AGAINST LIMITED SPEED.

The Buffalo, N. Y., Street Railway Co., was lately restricted by the board of councilmen to four miles an hour in the city and six miles in the suburbs. Since the reduction of speed was made, there have been many complaints, and the Real Estate Exchange has now unanimously adopted resolutions asking that a faster schedule be permitted. It pays the company a compliment in the preamble to its resolutions, saying that: "The Buffalo Street Railway Co. have with commendable enterprise and at great expense equipped many miles of their system in Buffalo with the trolley," which "has worked to great advantage in bringing the outlying districts of the city in close connection with the business centre."

ANOTHER ELECTRIC STREET CAR FENDER.

A successful test of an electric street car fender was recently made, it is reported, on the East Middlesex Street Railroad, Woburn, Mass. The fender is made of sheet iron and is attached directly to the framework of the truck. The lower plates come within about one inch of the rails, and are attached to springs of such stiffness that a fixed obstruction will pass under them while a movable object will be thrown aside. The fender will also serve as a snow plough.

MISCELLANEOUS.

ELECTRICAL TRANSMISSION OF POWER FOR COTTON MILLS.[1]

After a brief synopsis of the evolution of the electric motor, the various uses to which it is applicable and its advantages in cases where variable and intermittent service is required, the author confined himself to the consideration of electric work in cotton milling. The first motor used to operate an elevator in a cotton mill storehouse was installed in 1882 and is still in successful operation. The Salmon Falls Manufacturing Co. has 2,100 feet of track in the mill yard operated by the trolley system, the car running at an average speed of 600 feet per minute, moving all the cotton, supplies, cloth and coal handled on the premises, and taking the place of a team and three or four men. For inside service, the double overhead construction is necessary, as the occasional sparking at the rails, in the case of the single trolley system, is apt to ignite combustible material on the floors. The overhead wires should be thoroughly protected by guard wires, wherever a possibility of contact with other wires exists.

Electric cranes have great advantages in mills where constant service is required. The absence of heat, economy of space and ease of regulation possessed by motors fit them especially, also, for calico printing work.

Electrical distribution of power as a substitute for belt transmission has not yet been tried in cotton mills, but is, in the opinion of the author mechanically feasible. There is, of course, no doubt of its practicability in machine shops, but the amount of power required in cotton mills is very great, and the subdivision should be less than one unit to a room, so that when motors and generators, including wire and foundations, cost nearly or quite $100 per h. p., there seems to be some doubt as to the economy of the system.

At the Cumberland Mills, in Maine, 260 h. p. is transmitted over a mile by the Mather electric system, and motors are used to drive paper machinery, giving from poorly governed water wheels a sufficiently steady motion for calenders, but the compensation by the compound wound generators is not sufficient to remove the effect of all the variations of speed in the water wheels from appearing in the motors, and these motors cannot run Fourdrinier paper machines, although motors in these mills, deriving their power originally from a steam engine, perform satisfactory work in driving paper machines. At these same mills, an installation of motors is under way for the transmission of 1,200 to 2,000 h. p. for a distance of seven miles. As water wheels give sufficiently uniform speed for looms, and as motors do give a more uniform speed, there is but little question as to their mechanical suitability for such work.

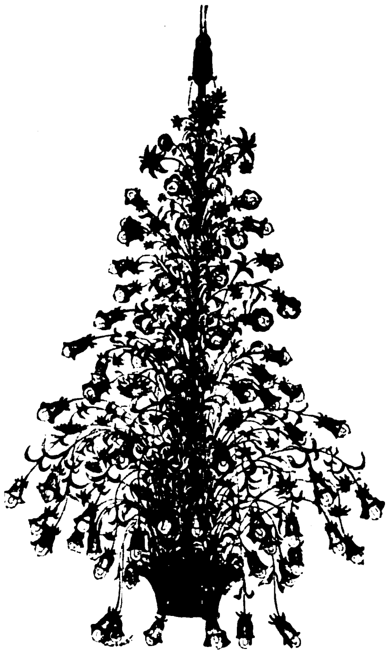
The Nonotuck Silk Company utilizes a waterfall of about 30 feet to run generators, whence power is transmitted to their mills at Leeds and Haydenville, the distance being ⅓ mile in one case and 1¾ in the other. There are two water wheels in use, one of 90 h. p., driving dynamos which furnish 950 incandescent lamps on an alternating system at the mills. The other 130 h. p. water wheel drives one Thomson-Houston generator of 85 h. p. and another of 30 h. p., the pressure of the current being the same as that used on trolley street cars. At the mills ⅓ of a mile distant is one motor of 45 h. p., two of 20 h. p., and one of 10 h. p., all supplied by electricity from the 85 h. p. generator. The 45 h. p. motor belts upon the main shaft, which is driven by two water wheels having a capacity of 100 h. p. under a 12½ foot fall. The water wheels are run at full gate without any regulator, but the motor serves as a regulator running at uniform speed and furnishing the remainder of the power, which has a variable range of 25 h. p. When the water falls too low for the water wheels and motor to run the mill, a steam engine is belted to the main shaft, the motor and water wheels furnishing their full capacity, and under these conditions the engine regulates the speed of the whole. Arrangements are being made to increase this plant.

The author then made some general statements in regard to long-distance electrical transmission of power, and referred to the natural advantages possessed by New England, where water power is being extensively utilized for this purpose. The present daily manufacture of incandescent lamps in this country is, he said, three times as great as the whole number in use here ten years ago, and there is no reason to doubt that the next decade will witness a comparable increase in the application of electricity to the transmission of power.

LETTERS TO THE EDITOR.

THE FIRST FIXTURE CALLED "ELECTROLIER."

In view of the forthcoming exhibition at Chicago, may we ask your permission to state that the celebrated electrolier originally manufactured by us for Mr. Edison's well-known exhibit at the Crystal Palace, 1882, has recently again come into our hands for sale?



The First Verity Electrolier.

It may be interesting to your readers to know that this is the *first* fixture to which the word "Electrolier" was applied, and it is in this and other respects a noteworthy curiosity, as it is one of the largest pieces of hand wrought floral work that has ever been manufactured. It stands about 16 feet high and is 10 feet broad, has 99 lights in three circuits, and originally cost over £350. It is now to be sold for £75; the metal alone in it is of considerable value.

Perhaps some of the prominent companies who propose making brilliant shows at Chicago, might feel disposed to utilize it "as the first electrolier that ever was constructed."

Verity & Sons.

London, Oct. 21, 1892.

[We are under the impression that the first "Electrolier" in the world is in the possession of Luther Stieringer, Esq , of this city, to whom it was given by F. R. Upton, Esq. It was put up at Menlo Park in 1880, and was fully described and illustrated in The Electrical Engineer, Aug. 12, 1891.—Eds., E. E.]

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[1] Abstract of a paper read by C. J. H. Woodbury before the New England Cotton Manufacturers' Association, Boston, Oct. 26, 1892.

MR. BALCH AND HIS UNIPOLAR CRITICS.

MY article on "Twisting Magnetism," in your issue of September 14, has attracted considerable comment, and I trust that a discussion has been opened that is not without profit to your readers.

My first critic in your issue of September 21 quotes S. P. Thompson as saying that the moving conductor should cut the magnetic lines so as to alter the number that passed through the circuit. This statement, apart from the context, is certainly in error, for, if it were true, no unipolar machine would yield a current; but unipolar machines do work, and for equal lengths of conductor across the lines of force they do generate as much E. M. F. as other machines. Professor Thompson's error is one which has been committed so frequently by writers before him, that it is not surprising that he also should have made it.

My second critic in your issue of October 5 assumes that my magnets were solid instead of tubular. This mistake, however, does not alter what he has to say, which is, that my two operative unipolar machines will work if connected up in series. Mr. Tesla's invention of corrugated pole-pieces, as suggested by another correspondent, is not the solution at which I was aiming, for he produces an alternating and not a continuous current.

Mr. Hyer's reply, among those you have published, alone appears to show a careful reading of my article, and I take pleasure in thanking him for his pains in answering several of the criticisms which have appeared.

The explanation that will show at the same time why some of my experiments were successful and others were not, will have to recognize the fact that magnetic lines form permanent closed loops, and this is a fact that is not deducible from mathematical laws. A comparison of electrostatic and magnetic phenomena shows that Coulomb's and Ohm's laws are equally true of each. The attraction between electrostatic bodies, as well as between magnets, is inversely as the square of the distance, and the effects of electro or magneto-motive force are with each equally in keeping with Ohm's law. When two magnets are brought near each other so that lines of force lie between their adjoining poles, other lines of force will connect their separated poles, thus closing the magnetic circuit; but, if we approach two electrostatic bodies so as to set up an entirely analogous phenomenon between their adjoining surfaces or poles, there need be no corresponding phenomena connecting their separated surfaces or poles. In other words, these two phenomena, identical in their mathematics, differ in the fact that magnetic attraction can exist only in permanently closed loops, while electrostatic attraction does not require to be closed. The departure of the analogy here has not been explained.

S. W. BALCH.

NEW YORK, October 28, 1892.

APPARENT MAGNETIC RESISTANCE.

I HAVE read with some interest Mr. Steinmetz's article in THE ELECTRICAL ENGINEER on "Apparent Magnetic Resistance," because the ratio which he there defines and describes is one which I have often used without giving it any other name than the mathematical one, $\frac{d M}{d F}$. But I would like to add one qualification to his use of it, which he appears to have overlooked in the example he gives of its application to alternators.

Those of your readers who are familiar with Ewing's researches in magnetism will remember the very interesting and peculiar "loops" which he traced out at different points on his hysteresis curves by reversing the order of change in the magnetizing force at some point of the ascending or descending curve, and, after going back on his tracks a short distance, again reversing and going on with the main curve.

A glance at these loops shows that they only coincide with the main curve at two points, where they begin and where they end. The apparent magnetic resistance at any point then will depend on whether that point is on the ascending or descending leg of the curve and whether the added ampere turns are positive or negative. Thus, in the example given by Mr. Steinmetz in the second paragraph of the second column of page 241, since the curve is evidently an ascending one starting from zero, the value 13.08 would apparently be attained if the superinduced magneto-motive force is positive. If, however, it is negative, the induction, instead of coming down the way it went up, would start off on one of Ewing's loops, and the value to which it would be reduced would be greater than the 12.82 which Mr. Steinmetz gives, and if the magneto-motive force is alternated between these values, the induction would keep on following around this loop and would not simply go up and down on the curve of induction given.

This fact is of great importance in the effect mentioned by Mr. Steinmetz as occurring in the field of an alternator, on account of the varying magneto-motive force of the armature, since it makes the change in the induction through the field much less than it would be if Mr. Steinmetz's assumption were strictly true. As an additional proof of the truth of this assertion it may be said that if the magnetism went up and down on the curve of induction given by Mr. Steinmetz, there would be no hysteresis in the field cores due to change of magnetism, and that there is hysteresis, as well as eddy currents, in the field cores under these circumstances, I have learned only too well by sad experience.

Whether this peculiarity is apparent in compound-wound dynamos or in other direct current machines I do not know. I have never heard of any one's having discovered it, and I have had neither the time nor the opportunity to investigate it experimentally myself, but I should say that it was at least an open question, since the changes are so slow that the mechanical vibration would furnish another factor to the problem and one whose effect appears to be little known. I have sometimes thought, however, that the difficulty experienced in running compound-wound dynamos and series-wound street car motors in parallel might have some light thrown on it by taking this peculiarity into consideration.

THORBURN REID.

SETTLING A POLE LINE DISPUTE AT PEORIA, ILL.

THERE has been considerable friction between the local Telephone Co. and the commissioner of public works.

Some time since, the city council presented the Telephone Co. with a new franchise for which they had long been asking One of the conditions of the ordinance was that the Telephone Co. should present a map of the city on which were to be shown the routes of the wires. This was not done till the time they commenced work on the new lines.

The commissioner of public works, under whose superintendence the work was to be done, found that they were erecting their poles on the same side of the street as the wires of Jenney Electric Light Co. are. He ordered work stoped, but they did not stop, so the whole gang of linemen was arrested but later discharged upon condition not to work on that street till matters were fixed.

The commissioner of public works, Supt. Matlock of the Telephone Co., Supt. Findley of the Central R. R. Co., the mayor and Manager Reyburn of the Telephone Co. held a meeting, the result of which was that the Telephone Co. is to pay the cost of removing the electric light poles and wires to the other side of the street. The Telephone Co. and the Central Railroad Co. and the Central Electric Light Co. are going to use the same line of poles on certain streets, the Telephone Co. to remove the other companies' poles.

This is something which was badly needed, as there are three different sets of poles on the street now.

NO TELEGRAPH COMBINATION.

DR. NORVIN GREEN, president of the Western Union Telegraph Company, says the reports concerning a proposed union between the Western Union and Postal Telegraph had not the slightest elements of truth in them. Mr. Mackay has also denied the reports.

PERSONAL.

MR. F. R. COLVIN, an old Rochesterian, who has made both fame and fortune as the treasurer and business manager of THE ELECTRICAL ENGINEER, of New York, has just paid a flying visit to this city, with the special object of making a thorough personal inspection of the Denio auxiliary fire-alarm system, owned and installed by the Standard Electric Signal Company, which was clearly illustrated and described in a recent number of THE ELECTRICAL ENGINEER. Mr. Colvin has expressed himself as much gratified with the workings of the system, and does not hesitate to predict its speedy adoption, far and wide.—*Rochester, N. Y., Democrat and Chronicle.*

OBITUARY.

M. F. HATCH.

MOSES F. HATCH, of New Bedford, Mass., general manager of the Southern Massachusetts Telephone Company, dropped dead in the Park Square Station of the Old Colony Railroad in Boston, last week.

E. M. HOLBROOK.

MR. E. M. HOLBROOK, C. E., who was injured by the bursting of a fly wheel in the Brush Eiectric Light Works, at Niagara Falls, N. Y., October 16, has died from the effects of his injuries.

LITERATURE.

Handbook of Tables for Electrical Engineers. The John A. Roebling's Sons Co. Trenton, N. J., 1892. Pages, 119. 4½ x 7 inches. Price, $1.50.

WITH the great increase in the field of electrical industries in the past few years, there is a demand for special information which is not to be found in the older handbooks. This handbook is designed to give to the electrical engineer, in the form of tables, information which he could hardly obtain from any other source, or which would require long and tedious calculation. The book contains about 100 tables; these are divided into general tables, general tables of the line, calculations of the line, the overhead line, and the underground line.

Under the head of General Tables, only one can be noticed. It includes the metric system and all the English measures for length, area and volume. It gives at once the multiplier and its logarithm for changing from one unit to any other. In the table of lengths there is given the multiplier for changing inches into feet, yards, metres, chains, kilometres, miles and knots, and the same information is given for each unit of length. In a second table on the same page the logarithms of the multipliers are given.

Under "General Tables of the Line" there is a table giving the resistance of one mil foot of copper wire at various temperatures, calculated from Matthiessen's figures as given in the report of the Standard Wiring Table Committee of the American Institute of Electrical Engineers, September 16, 1890. This table will be appreciated by those who have to determine the percentage conductivity of copper wire. Following this are two tables, one giving the diameter and area in both square and circular mils, the other giving the resistance of wires per 1,000 feet in legal ohms and B. A. units at temperatures of 55° and 70°, according to all the wire gauges in use.

Under calculations of the "line", there are tables for wiring. From ½ to 9½ volts loss, inclusive, the resistance of the circuit is worked out for 100 amperes. From 10 volts loss to 20, the resistance is worked out for 200 amperes. To be used in connection with this table, is a table giving the resistance of copper wires from No. 0000 to No. 20 B. & S. The lengths for which resistance is given vary from 2,000 feet for the No. 0000 to 200 feet for the No. 20.

Following this are tables giving the formation of copper strands, the safe carrying capacity of wires, and complete tables of strains, lengths and deflections in the wire of spans. These tables were calculated so as to apply to the lengths of spans used in telegraph and electric railroad work. On page 115 there is a table giving the weight of wire from No. 12 B. & S. to 500,000 c.m. per 1,000 feet and per mile, bare, double braid and triple braid insulation. The last tables of the book are devoted to size and weights of all kinds of lead-encased cables, telegraph, telephone and electric light.

The book also contains a handy wiring chart, which, in connection with the tables mentioned, will greatly aid the laying out of electric light and power circuits.

Telegraphic Connections: Embracing Recent Methods in Quadruplex Telegraphy. By Charles Thom and Willis H. Jones. New York: *D. Van Nostrand Company.* 1892. Long 8°; pp. 59; 20 plates in colors. Price, $1.50.

WITHIN three or four years after the establishment of the first commercial telegraph line in the United States, the rapid growth and extension of the new system of intercommunication rendered necessary the invention of appliances for coupling different circuits together at junction points, in order to facilitate the interchange of business, and thus switches and repeaters first came into being. A quarter of a century later, the introduction of duplex, followed after a brief interval by the quadruplex method of working, brought many additional complexities and refinements into the organization of terminal stations. Then came the era of special and leased wires, and finally the whole terminal system had to be remodeled and reconstructed in order to adapt it to the changed conditions brought about by the substitution of dynamo-electric machines for the time-honored voltaic battery in the larger telegraphic centres of the country.

It has resulted from these conditions, that while the apparatus of the great majority of telegraphic stations has undergone but little change in form, and none at all in principle, for the last quarter of a century, a great number of special forms of apparatus and methods of working have been evolved by the incessant increase in the volume of service in the larger stations, the knowledge and understanding of which is practically limited to a comparatively small number of experts of long experience and of self-acquired skill.

While the work of Messrs. Thom and Jones is not the first attempt to produce a treatise dealing with the practical aspects of the service in the larger telegraphic stations of the present day, it is the only one of which we have any knowledge, which has been carried out in a way calculated to commend itself to the approval of the particular class of telegraphic employees for whose benefit it has apparently been prepared. It would be easy to criticise the work as a literary performance, but it would be most ungracious to do so, for it cannot be denied that the authors at least are familiar with their subject, and that they have sought to the best of their ability to impart their knowledge to others. Moreover there is no reason whatever to suppose that the average telegraphic operator will experience any serious difficulty in understanding the explanations.

The work, as a whole, has several very conspicuous merits. In the first place, it is neither too large nor too costly. It covers but a limited field it is true, but it is one that is only partially embraced in the scope of any prior work, and it must be admitted that it covers it thoroughly. The book is convenient in size and form, so that it may lie in a drawer of the instrument table, always at hand for reference when needed, without being in the way when not needed. As to the chief feature of the work, the illustrative diagrams of apparatus and connections, it would be difficult to speak in too high terms of praise. They are not only admirably designed, but are engraved in the finest manner, and printed, whenever necessary, in three colors, so that the most intricate arrangement of circuit-connections may be comprehended at a glance. They are beyond comparison superior to anything of the kind of which we have any knowledge. With such diagrams as these, labored and minute descriptions are tiresome and superfluous, and have been for the most part wisely omitted.

Many new devices are described and figured, which have only come into use during the present year, as a result of the complete reorganization and reconstruction of the New York station of the Western Union Telegraph Company, rendered necessary by the destructive fire of two years ago.

It goes almost without saying, that every telegraphic operator who cherishes an ambition to rise above the endless and toilsome grind of the key and sounder, will find ready to his hand in this book, a store of knowledge not easily attainable elsewhere, which cannot but prove of the utmost service to him in his efforts to render himself worthy of promotion. As a convenient work of reference, it possesses moreover, even to the expert, a distinct and positive value.

The publishers have done their work well. The engraving, printing, paper and binding are all of the best quality, and literally leave nothing in these respects to be desired. It is but fair to say that the plates are as nearly as possible fac-similes of drawings executed by one of the authors, and they certainly are of a quality and style which reflect the highest credit upon his taste and skill.

Electric Traction on Railways and Tramways. By Anthony Reckenzaun, C. E. London: *Biggs & Co.* New York: *D. Van Nostrand Co.* Cloth, 422 pages and index. Price, $4.00

THOSE of us who had the pleasure of making the acquaintance of Mr. Anthony Reckenzaun in this country a few years ago, when he came here to take a hand in the development of storage traction, will be prepared for something worth reading in this book, and they will not be disappointed. On the contrary they will be confirmed in the belief, that had he remained here, not only would storage traction have been much further advanced, but he would not have been reduced to the necessity of recording so much of other men's work in this, his chosen field of electrical application.

It is needless to say that Mr. Reckenzaun could only write a helpful and instructive book, no matter what his disadvantages in the way of observation of actual work, and the treatise before us can be heartily recommended as a study of something more than familiar facts and surface indications. There are only half a dozen chapters in the book, but each is well planned and well weighed. Perhaps that on storage work is the most valuable to the American electrical engineer, as it embodies results of personal practice and experience and the suggestions of a shrewd observer. It is moreover, of a cheerful and sanguine cast. We object, all the same, to the placing of Figs. 48 and 49, referred to in this chapter, just 100 pages ahead of the reference. This is like the annoying habit of American magazines, which put all their beautiful cuts in a bunch on the fine coated paper, and then let the text they relate to straggle along a score of pages later, on "ornery" 10 per cent. rag.

The main point is, however, that Mr. Reckenzaun adheres to his liking for storage traction; and we can see no reason why, in the long run, he will not be found right and justified. So, too, we note that his convictions as to the suitability of the worm gear remain unchanged. He argued for worm gear when among us in America and he is not slow to point out its merits to-day.

Of minor defects the book exhibits but few. It complains that total efficiency tests of electric railway systems are few and not often accurate. Our opinion, on the contrary, is that we are getting too many of these tests and that they do but confirm each other, evincing a fair average of accuracy. If one could only persuade our graduating electricians to do aught else than make an efficiency test of an electric road for their theses, life would be far more worth living. We note, too, that Mr. Frank J. Sprague is referred to on page 121 and elsewhere, as though he were still pegging away at street car motor regulation. As a matter of fact, Mr. Sprague long since tackled heavier problems than this in electric locomotion, and we doubt very much whether he has deigned to dally with the old Sprague car motors since their change of financial control relieved him of worry as to the electrical. So, too, we observe the Bentley & Knight conduit system spoken of on pages 165 and 166, in respectful terms of the present tense. That system, excellent as it was in many respects, had its day and ceased to be several years ago, after absorption in the usual Nirvana fashion by the Thomson-Houston Company; but perhaps we shall see it again some day in a further stage of metamorphosis.

The book is got up in good shape, and is well printed, though some of the engravings have that tired feeling and look which would indicate frequent service. There should be a law, we think, to exempt cuts from duty after a given term of work. The printing press is a Sullivan that will "knock the stuffing" out of even the hardiest electro. But in the main, the illustrations are clear and useful, and Mr. Reckenzaun is as moderate in employing them as he is in resorting to adjectives when describing the machines and plants they relate to. It is sincerely to be hoped that Mr. Reckenzaun will come over and see us next year. This country will then furnish him with all the new data, fine cuts, and superlative adjectives that he can possibly squeeze into his second edition. Meantime, we hail his admirable book as the only European production on this subject worth reading on both sides of the Atlantic.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED OCTOBER 25, 1892.

Accumulators :—

Secondary Battery, W. Main, Brooklyn, N. Y., 485,018. Filed Feb. 15, 1892.

Comprises a number of improvements upon the former Main batteries, one of which is a vertical copper plate supporting electro-deposited zinc.

Finishing Grids for Secondary Batteries, A. F. Madden, Newark, N. J., 485,128. Filed June 17, 1891.

Conductors, Conduits and Insulators :—

Wire Coupling, W. E. Banta, Springfield, Ohio, 484,842. Filed, Sept. 12, 1890.

The coupling is composed of coiled wires joined together and adapted to bite into the line wires under the coupling strain.

Closed Conduit for Electric Railways. B. F. Sutton, Brooklyn, N. Y., 484,924. Filed July 7, 1891.

Employs a tube of insulated material free to collapse and expand, and enclosing a conductor; a number of separate conducting services on the interior of the tube, and a conducting surface on the exterior of the tube, communicating electrically with the separate conducting surfaces when the tube is compressed.

Insulator for Electric Railway Conductors, C. T. Lee, Boston, Mass., 485,105. Filed March 17, 1892.

An insulated wire handle, in which the insulated part and the case containing them may be rotated within the collar.

Insulator, C. T. Lee, Boston, Mass,, 485,106. Filed March 17, 1892.

Consists of a block composed of mica sheets secured together and a spindle passing partly through the block.

Dynamos and Motors :—

Magneto-Electric Generator, S. Evershed, London, England, 484,785. Filed Jan. 8, 1892.

A dynamo-electric generator which, when used with an ohmmeter, will give a constant electromotive force.

Regulation of Alternating Current Generators, G. Pfannkuche, Cleveland, Ohio, 485,054. Filed Nov. 30, 1887.

Relates to system of regulating of alternating current generators whereby the latter become adapted for use in general systems of distribution in which the number of translating devices is variable.

Galvanic and Thermo-Electric Batteries:—

Standard Cell for Electric Batteries, H. S. Carhart, Ann Arbor, Mich., 485,089. Filed July 11, 1892.

Employs a mercury salt connected with one terminal of the cell, a zinc element connecting with the other terminal, an electrolytic fluid in contact with the zinc and mercury salt, and a porous partition between the latter.

Lamps and Appurtenances :—

Incandescent Lamp, F. S. Smith, Pittsburgh, Pa., 484,825. Filed Feb. 29, 1862.

Invention consists in making the enclosing chamber in two parts, the larger part being of glass and the remainder of a soluble material which will make an air-tight joint with the glass part and may be separated therefrom by immersion in a proper solvent. (See THE ELECTRICAL ENGINEER Nov. 2, 1892.)

Electric Search Lights, L. Hills, New York, N. Y., 484,964. Filed Sept. 24, 1891.

Relates to methods of mounting and moving the frame of the projector.

Miscellaneous :

System for Adjusting to Temperature Watch Balances and Hair Springs, G. E. Hunter, Elgin, Ill., 484,796. Filed Jan. 26, 1892.

Employs an electric device for registering a number of vibrations of a standard balance or spring for purposes of comparison.

Mechanisms for Timing and Adjusting Watch Balances and Hair Springs, G. E. Hunter, Elgin, Ill., 484,797. Filed Jan. 26, 1892.

Similar to 484,796.

Process of Separating Gold and Other Metals from Their Ores, G. T. Atkins, London, England, 484,869. Filed April 28, 1891.

An electrolytic method of separation.

Process of Separating Iron from Ore, M. F. Eaton, Chicago, Ill., 484,877. Filed April 6, 1889.

A system of magnetic separation.

Electric Converter, L. Gutmann, Fort Wayne, Ind., 484,959. Filed Feb. 5, 1889.

Claim 1 follows:

The combination with energizing coils of a core composed of superposed insulating plates and a conductor connecting electrically plates separated from one another by others.

Trolley-Pole Catcher, M. M. Wood, Chicago, Ill., 484,986. Filed June 4, 1891.

Employs a motor to which is attached the rope leading to the trolley pole and which is actuated by the tension of said rope caused by the trolley leaving the wire.

Electrolytic Process and Apparatus, H. Blackman, New York, N. Y., 484,990. Filed Jan. 15. 1892.

Claim 1 follows:

The improved electrolytic process consisting in subjecting an electrolyte to centrifugal action during the electrolysis, whereby the resulting products of different specified gravities are separated.

Electric Soldering, E. E. Ries, Baltimore, Md., 485,017. Filed July 17, 1891.

Railways and Appliances :—

Electric Railway System, J. H. Pendleton, Brooklyn, N. Y., 484,919. Filed Aug. 1, 1891.

Combines in its structure a supply conductor, a sectional working conductor, interposed energizing sections, a primary branch wire for each section of the working conductor, leading from the supply conductor and including an electromagnet, and a second branch wire for each energizing section leading from the main branch wire to the energizing section; the one coil of the electromagnet being included in both branch sections.

Switches and Cut-Outs :—

Thermal Circuit Changer and Protective Appliance, H. A. Rodes, Denver, Col., 484,822. Filed March 11, 1892.

Employs a substance having a high coefficient of expansion enclosed in a vessel having an elastic wall, for the purpose of making and breaking contacts under the influence of greater or less degrees of heat.

Automatic Cut-Out, C. E. Sanford, Brooklyn, N. Y., 484,865. Filed May 17, 1890.

Consists of a series of electromagnets whose resistances diminish in a prescribed ratio, and which are each provided with an armature acting as a circuit cut-out for a branch circuit.

Ceiling Block, J. J. Green, Boonton, N. J., 484,911. Filed May 17, 1892.

Employs an annular packing between the block and the cover for the purpose of excluding moisture.

Electrical Switch, G. Binswanger, London, Eng., 485,028. Filed May 6, 1892.

Employs a contact bar, a rocking handle, a cam thereon bearing upon the bar, a spring to lift the bar, and a link loosely connecting the bar and handle.

Telephones and Apparatus :—

Telephonic Transmitter, A. T. Collier, St. Albans, Eng., 484,778. Filed Dec. 8, 1891.

Employs a diaphragm secured upon an annular frame suspended upon a rod depending from a support pivoted to the frame of the transmitter, and means for adjusting the diaphragm and its electro with respect to the back electro.

Test Circuit for Multiple Switchboard Systems, C. E. Scribner, Chicago, Ill., 484,867. Filed Mar. 1, 1890.

Employs an electromagnet introduced between the last switch of the multiple switchboard system and the test rings of the switches; the armature controlling contact points which are included in a branch circuit to ground.

Telephone Support, G. V. Benjamin, Ithaca, N. Y., 485,027. Filed Mar. 19, 1892.

LEGAL NOTES.

EDISON ELECTRIC LIGHT COMPANY AND EDISON GENERAL ELECTRIC CO. vs. SAWYER-MAN ELECTRIC CO.

THE hearing in the Edison suit against the Sawyer-Man Co., on the new motion for preliminary injunction, appointed for Friday, November 4, and noted in our columns last week, was on that day postponed for one week—till Friday, November 11.

CHANGES IN WESTERN UNION RATES.

SEVERAL changes in the rates for telegraphic messages made by the Western Union Company, which went into effect on Oct. 1, have escaped notice, except among those who have considerable telegraphing to do, and to whom the slightest reduction in rates means great saving of expense.

The most important change which has been made is in the manner of charging for numbers. Formerly, in a number, every figure was counted as one word, but under the new system figures, letters, commas, points, and bars of division, or any combination thereof, (as in cipher messages), are counted three figures, letters, or signs to the word, and any group thereof of less than three figures, letters, or signs is also counted as one word. To prevent liability to error, numbers and amounts should be written in words, and this makes no difference in the charge.

Other changes which have been made are in reference to the body of a message where dictionary words, initial letters, surnames of persons, names of cities, towns, villages, States or Territories, or names of the Canadian Provinces are counted and charged for as only one word, while in the names of counties and countries all the words are counted.

Thus the names of cities and towns, as New York, St. Louis, White Plains, count only as one word each, while New York County is charged for as three words.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

The mint is the only place where money is made without advertising.

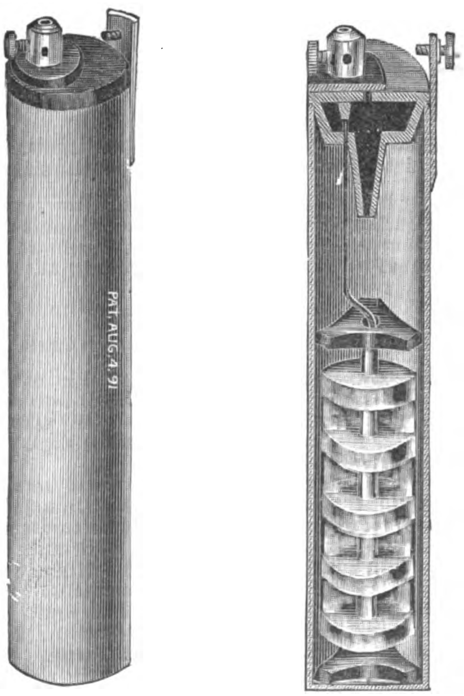
THE NEW "HARD" DRY BATTERY AND BELL.

There are many situations where a handy portable cell can be applied with advantage, not only in electrical testing work, but also in the more general electric bell and annunciator work, where heretofore the ordinary open circuit galvanic cell has been employed.

In seeking to devise a practical commercial cell of small size and of durable quality for these purposes, Mr. J. Randolph Hard has recently succeeded in developing a new type of the chloride of silver cell, which possesses a number of valuable features. Our engraving, Fig. 1, shows the cell complete, in full size, and its internal construction will be readily understood from an inspection of Fig. 2. Here it will be seen, that the silver wire passing down from the outer terminal has cast around it a number of discs of chloride of silver, between which an exciting paste is inserted, which acts as the electrolyte. This silver wire is maintained in a central position by a triangular washer above and below the chloride discs.

One of the greatest difficulties heretofore encountered with the chloride of silver cells is their bursting, owing to the pressure of the gas generated by the action of the cell. To avoid this, Mr. Hard has inserted at the top of the cell a funnel-shaped hard rubber stopper, having a small perforation at its centre. This perforation is covered by a soft-rubber flap placed under the terminal post, which acts as a valve. Normally the rubber flap seals the top of the funnel, closes the central orifice, and thus prevents the evaporation of the electrolyte. But it is evident that any gas generated when slightly exceeding normal pressure, readily escapes by the valve, which immediately closes the orifice again. The funnel shaped stopper also prevents the liquid, which is generated by the action of the cell, from slopping over when the cell is placed in an inverted position, as it may be placed occasionally. The liquid it will be evident flows around the funnel, and the nozzle prevents it from overflowing; the liquid generated being of such small volume as not to exceed the height of the funnel.

The action of the cell is very constant. It has been used with success in ringing door bells, operating burglar alarms, electro-medical apparatus, testing work, etc. Two such cells are able to ring a bell vigorously, and as they can be placed in a small case, the time and expense are greatly obviated, it being unnecessary to run the circuit to batteries kept in cellars or closets, as is now generally done.



Figs. 1 and 2.—New "Hard" Dry Battery.

The vibrating bell recently brought out by Mr. Hard, which is illustrated in Fig. 3, also embodies several novel features. In the first place the use of all pivots has been avoided by suspending the armature in front of the electromagnet upon a spring, its centre of vibration coinciding with the hole in the box through which the hammer rod passes. The brass spring to which the armature is attached also carries near its central portion, the contact which makes and breaks the current.

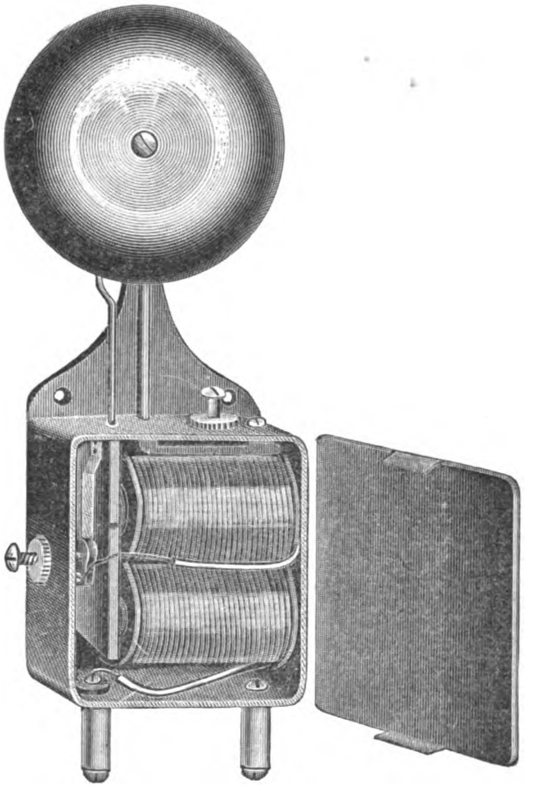


Fig. 3.—New "Hard" Vibrating Bell.

By the arrangement here adopted a very small amount of current is required to operate the bell, and there are no false vibrations produced. It will also be noted that the hammer strikes the inside of the bell instead of the outside as is usually the case. By this arrangement the danger of getting the bell out of adjustment when cleaning or dusting is entirely avoided.

As is stated above, the armature is so hung that the centre of vibration coincides with the hole through which the hammer arm passes. The result of this is that this hole requires to be only sufficiently large to allow the hammer arm to pass through comfortably, and still without interfering with the free vibration of the rod. This close fit between the hammer rod and the hole, makes the bell perfectly dust and insect proof. The front of the bell box is closed by a lid, which is held in position by tongues above and below, that lock the lid firmly in position.

These devices are now being regularly manufactured by Mr. J. Randolph Hard, 2 and 4 Howard street, New York.

THE DIXON POWER AND LIGHTING CO.

The new station of the Dixon Power and Lighting Company, of Dixon, Ill., is rapidly approaching completion. The building is six stories high, 80 x 50 feet, and has an addition for a boiler house, and the dynamo shaft is so arranged that the generators may be run all by steam, all by water power, or part of the number by each. The Thomson-Houston system will be used, and the steam plant will consist of two 125 h. p. Armington & Sims high speed engines, with a 400 h. p. Babcock & Wilcox boiler.

There will also be three 90 h. p. New American and one 90 h. p. Leffel water wheels, each provided with a Woodward governor. It is the intention of the company to make the plant a model one in every respect. The dynamo shaft is equipped with 10 Eclipse friction clutch pulleys. Rope drive transmission is used on the water wheel shaft and the countershafts, and belts on the dynamos.

The company is capitalized at $75,000, and will furnish light and power over circuits aggregating 28 miles in length. The officers are: F. A. Watson, president; George Steel, vice-president; G. C. Loveland, secretary and treasurer; E. P. Maxwell, superintendent, and P. E. Cowles, electrician.

IMPORTANT NEW MEASURING APPARATUS.

The study of applied electricity is now so universal that high schools as well as colleges devote considerable time to the subject. Apparatus adapted for research work is quite too costly for elementary instruction, and in consequence until recently many schools have not been able to treat this important branch as fully as was desirable. Instrument makers are appreciating the need for first-class elementary instruments, and in this issue we give a brief description of a few important pieces which are being placed on the market by Messrs. Queen & Co., of Philadelphia. The different pieces have been designed in their laboratory, and are constructed substantially, but without the same degree of finish which is placed on the finer apparatus that this firm makes.

Fig. 1 shows a D'Arsonval galvanometer intended to be placed against the wall of a laboratory. It has a graduated scale with pointer and also a mirror, so that readings may be taken directly or by means of a telescope or lamp and scale. This instrument is extremely dead beat, and is adapted for general work where quick measurements are desired.

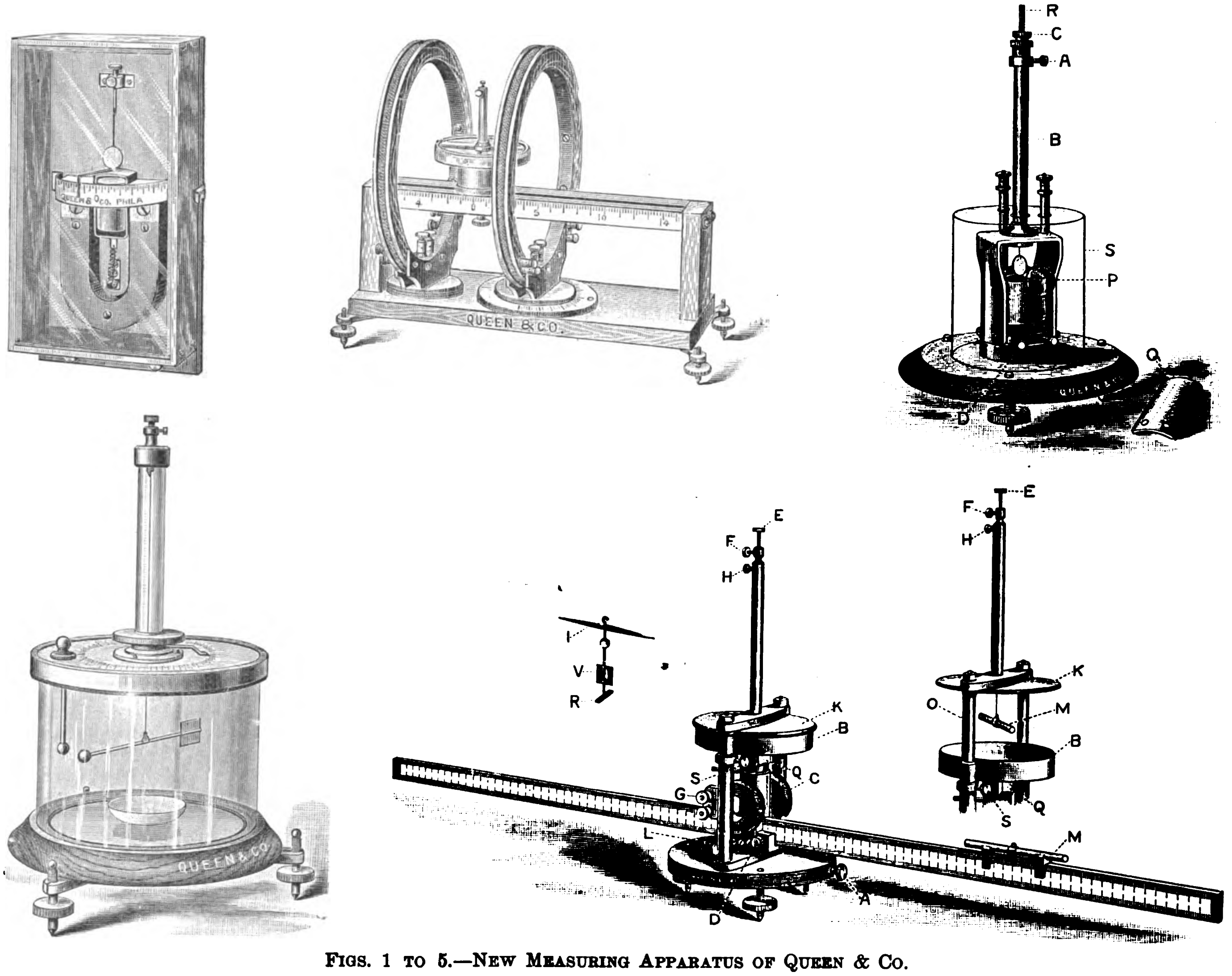
Fig. 2 represents a universal tangent galvanometer which is especially designed for determining current in absolute measure and for showing the effects of variation in the different quantities contained in the tangent galvanometer equation. It has two mahogany rings, built up of a number of pieces to prevent warping. One ring is wound so as to rotate freely on a vertical axis, with a pointer and scale graduated to degrees for use in sine measurements. The compass box slides along the horizontal graduated bar so that the needle may be placed in the plane of either coil, as a tangent galvanometer; midway between them as in a Helmholtz Gaugain galvanometer, or at any point upon the axis outside the places of both coils as in the Weidemann type. The instrument can thus be used for a great variety of purposes.

The quadrant electrometer, Fig. 3 is intended for use by the beginner, and is of simple construction while capable of a high degree of accuracy. The quadrants are fastened to a circular block of hard rubber, two of them being made of one piece of metal bent so as to have a level surface on top, to which the brass suspension tube and one binding post are attached. The aluminum needle, provided with mirror for reading deflections and vanes for damping the system, is suspended from an adjustable torsion head, thus connecting it with one pair of quadrants. In this way the Leyden jar arrangement, otherwise necessary for maintaining the needle at a high potential is avoided. A metal case encloses the apparatus, leaving room inside for a small dish of sulphuric acid and pumice stone for drying purposes.

Fig. 4 represents a coulomb electrometer which differs from other types in that the suspension tube is free to rotate, and at the bottom carries a pointer which moves over a scale graduated on top of the glass case. A mirror is placed in the bottom of the case to avoid parallax.

Fig. 5 represents a very convenient form of magnetometer which will prove invaluable for laboratory work. The illustration is very clear, so that it is not necessary to give details of construction. Observations may be taken either directly by aid of pointer deflections or by the telescope and scale method, a mirror being attached to the magnet system. Results almost as accurate can be obtained with this apparatus as with the well-known "Kew" pattern which is very much more expensive.

Messrs. Queen & Co. are issuing a special circular containing prices and full particulars in reference to these instruments.

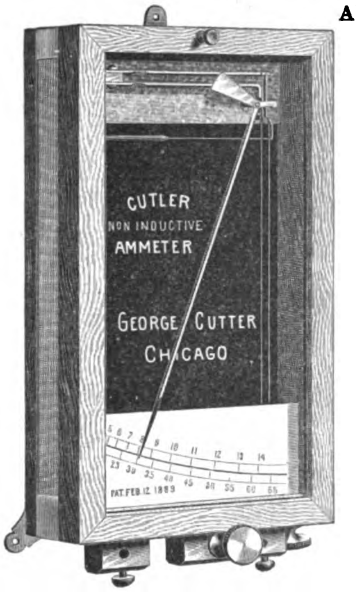


Figs. 1 to 5.—New Measuring Apparatus of Queen & Co.

ELECTRIC ENGINEERING AND SUPPLY COMPANY.

The above concern of Syracuse, N. Y., report themselves extremely and even "uncomfortably" busy. Their big World's Fair order is progressing nicely, but they are compelled to run night and day to meet the requirements thereof and to keep up stock for regular customers at the same time. They are putting in additional machinery, and expect to catch up with and supply the demands no matter what the increase in their future trade.

THE CUTLER NON-INDUCTIVE AMMETER.



Cutler Non-Inductive Ammeter.

ALL of the ammeters on the market with perhaps a single exception, depend on magnets for their action, so that their readings are largely influenced by the presence of iron masses near by, In a station where there has to be so much heavy machinery, this factor oftens spoils all dependence on the readings. And even if the instruments are placed at a distance from the dynamo and engine-room, two of them placed side by side will affect each other's readings. These are a few of the reasons why an ammeter having no magnets ought to be more reliable and better adapted to central station work than any magnetic instruments.

The non-inductive ammeters devised by Mr. H. H. Cutler depend on the difference in expansion of two fine wires, one of which is traversed by the current to be measured while the other compensated for changes in temperature of the room. The two wires are fixed at one end and are kept taught by flat springs carrying two knife-edges. A yoke resting on these bearings carries a light pointer, the leverage being such that quite a small expansion of the measuring wire will move the needle across the scale. The instrument is practically dead beat, and could be set on the pole-piece of a dynamo without affecting its readings.

The cut illustates an ammeter made with a double scale to read up to 65 amperes, the scale being much longer than in most instruments of this kind. This ammeter is equally accurate on direct or alternating circuits and steady use for the past six months has shown it to meet the needs of central station practice. It is built in sizes ranging up to 160 amperes, to meet the varied requirements of different stations, and the maker, George Cutter, of Chicago, is finding quite a demand for it.

SUBDIVISION OF POWER.

THE most persistent advocates of subdivided power, as engineers, have probably been Messrs. Westinghouse, Church, Kerr & Co., and many important plants have been designed by them on this basis. The results are beginning to speak for themselves and are of interest.

In the great Spreckels sugar refinery the subdivision of power involved over 60 high-speed engines distributed on every floor of the enormous building; most of them set without foundations. Non-compound engines were employed, from the fact that the various processes utilized all the exhaust steam which could be made. An order has just been placed with M. R. Muckle, Jr., & Co., of Philadelphia, for five more Westinghouse "Standard" engines, four of 100 h.p. and one of 75 h.p., making 68 engines now operating in this refinery.

The master mechanic keeps on hand a set of duplicate parts for each size of engine, and when a part is worn out, or an accident occurs, it is at once replaced; the old part being returned to the shop and overhauled at leisure.

A similar subdivided plant, involving 42 engines, was installed at the print works of the Dunnell Manufacturing Company, Pawtucket, R. I., and its chief engineer reports that the total repair bill for the first year of continuous operation was less than three dollars.

RECENT SALES OF ERIE BALL ENGINES.

THE BALL ENGINE Co., of Erie, Pa., report the following recent shipments:

General Electric Co., Atlanta, Ga., one 150 h. p. engine; Lake Shore Iron Works, Marquette, Mich., one 60 h. p. engine; Risdon Iron Works, San Francisco, Cal., one 25 h. p. engine; Badenoch Bros., Englewood, Ill., one 600 h. p. engine; Calvert Building and Construction Co., Baltimore, Md., one 80 h. p. engine; Calvert Building and Construction Co., Baltimore, Md., one 130 h. p. engine; Calvert Building and Construction Co., Baltimore, Md., one 35 h. p. engine; Excelsior Electric Co., Port Huron, Mich., one 400 h. p. engine; F. R. Dravo & Co., Pittsburgh, Pa., two 80 h. p. engines; F. R. Dravo & Co., Pittsburgh, Pa., one 100 h. p. engine; F. R. Dravo & Co., Pittsburgh, Pa., two 25 h. p. engines; Crook, Horner & Co., Baltimore, Md., two 80 h. p. engines; Crook, Horner & Co., Baltimore, Md., one 60 h. p. engine; J. H. Kuehling, Washington, D. C., one 60 h. p. engine; Risdon Iron Works, San Francisco, Cal., one 150 h. p. engine; General Electric Co., New York City, one 100 h. p. engine; General Electric Co., New York City, one 100 h. p. engine.

THE WESTINGHOUSE RAILWAY SYSTEM IN NEW ENGLAND.

MR. R. S. BROWN, the active and debonnaire agent of the Westinghouse Company in New England, reports a number of new orders for street railway apparatus. The Holyoke Street Railway Company has ordered four car equipments of two 20 h. p. motors to each car; the Hartford and Wethersfield Company one 250 h. p. generator and three car equipments of 60 h. p.; the Worcester Consolidated Company two car equipments of two 20 h. p. to each car; and last, but not least, 12 car equipments of two 20 h. p. motors to each car for the Springfield, Mass., Street Railway Company. Mr. Brown regards this last order as the best possible refutation that could be given of certain figures published recently with the object of showing that the Springfield Company did not think much of the efficiency of the Westinghouse apparatus.

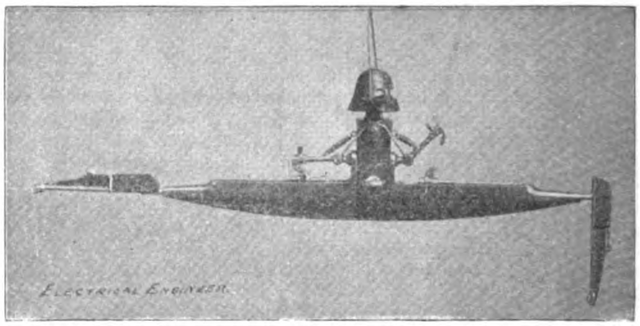
THE COMMERCIAL ELECTRIC COMPANY.

THE above company has been organized in Indianapolis to manufacture dynamos and motors under Mr. A. D. Adams' patents and they are about to place on the market a complete line of machines embodying novel features of construction. Mr. Jos. R. Evans is president; Mr. S. L. Hadley, secretary; Mr. W. A. Evans, treasurer, and Mr. A. D. Adams, manager of the new company. Their office and factory is situated at No. 113 South Tennessee street, and their machines will include power generators, lighting and plating dynamos and motors of all sizes. Mr. Adams has had considerable experience in the manufacture of electrical machinery and the new company ought to experience no trouble in securing a large and profitable business.

THE JOHNSTON DISCONNECTOR.

THE accompanying illustration shows the latest improvement in the Johnston safe automatic disconnector, with the original form of which our readers are already familiar.

This device, when applied to any wire bearing a dangerous current will, in the event of the rupture of the wire from any cause instantly break the circuit, and the wire will fall to the ground uncharged and can be handled with impunity. It offers special advantage and facility for repairs to any portion of the line without interference with the service of any section except that where repairs are to be made, and without in any manner affecting the machinery at the power house.



NEW JOHNSTON DISCONNECTOR.

In addition to the springs and clips, the new form of this device has a fuse wire as shown, which will blow in the improbable event of the springs' failure to act. As will be seen also, each end is hinged to the main portion and will fall by gravity the moment the wire breaks.

The device is manufactured by the Johnston Safe Automatic Electric Co., Richmond, Va., of which Mr. A. Langstaff Johnston is president and Mr. F. B. Jacobs is secretary and treasurer.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.
VOL. XIV. NOVEMBER 16, 1892. No. 237.

THE TUDOR ACCUMULATOR IN CENTRAL STATIONS.

BY

Dr Paul Schoop

IT seems that a "well known" American engineer is in doubt as to the early introduction of accumulators in American central stations, judging from an editorial on "Storage Batteries in Central Stations" appearing in THE ELECTRICAL ENGINEER, of August 31. The statements there made are so entirely misleading that one would be at a loss, in my opinion, to go further in the wrong direction. I beg therefore to be allowed to clear up one mistake after another. The editorial stated, "Our informant tells us that he was struck with the smallness of the plants." I give below a list showing the sizes of half a dozen plants in Germany (see page 468).

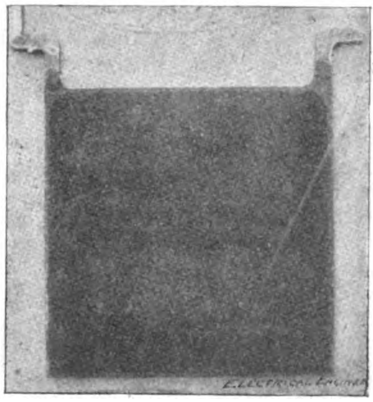


FIG. 1.—TUDOR ACCUMULATOR, POSITIVE PLATE.

To be struck by the smallness of a plant whose capacity is nearly 3,000 h. p. hours, and whose normal discharge is 625 h. p. (in case of emergency for short intervals even double that number, or 1,250 h. p.)—and this for the accumulator battery alone, is certainly worthy of note. "The load diagrams" says your informant, "are Alpine in the sharpness of their peaks and the sheer depth of their valleys," but he gives no reasons for, nor does he prove, this very doubtful assertion. Are the days in Europe constructed differently from those in America? Or do Americans work during the night and sleep in the day time? It might be well to compare the load diagrams of the stations mentioned in the above table with those of the Edison stations in New York and Chicago. The writer, however, does not believe that there should be such a difference between American and European load diagrams as a rule.

Your informant finds further an "undue proportion of the batteries to the generating plant in space occupied." Here again we have proof that your informant did not have complete data on the subject. As a rule the battery does not occupy more space than a dynamo plant, including the necessary steam engines and boilers. Only in such cases where gas engines are used would the proportion appear to be unduly great. I believe that the space required by a battery is, up to the present, one of the least obstacles to its introduction. But if fault must be found at all hazards it must be confessed that the much-sought-for battery in a cigar box would constitute actual progress.

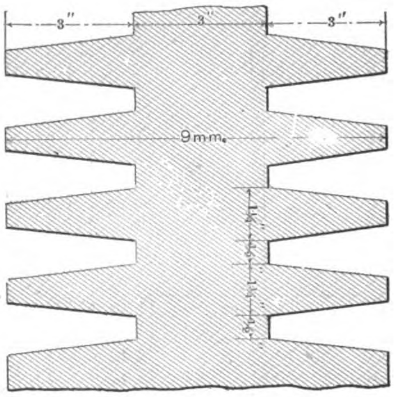


FIG. 2.—SECTION OF TUDOR POSITIVE PLATE.

I hardly agree with the remarks of THE ELECTRICAL ENGINEER, that "as for care bestowed upon the apparatus that is a lesson we still have to learn from the Europeans and the Japanese." Because an apparatus requires supervision, and a treatment different from that of a dynamo, the trained observer heaves it into the scrap heap—and makes an assignment (of his perfect inability to take care of electrical apparatus). If the amount of care required were such an important item as would appear from the remarks of your informant, it would make the central stations in Germany less profitable than they are. It seems more probable that the American engineer whom you quote

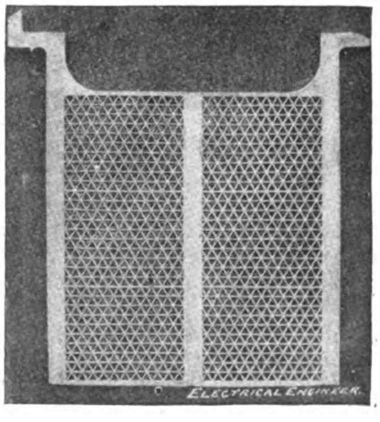


FIG. 3.—TUDOR NEGATIVE PLATE.

had formed his opinion before he went abroad, and has succeeded in sticking to it in spite of the impressive stations he saw. I admit that it is not unnatural that sore feelings should exist in some quarters on the subject of accumulators, considering the many unfortunate experiences with them, especially in America.

The Electrical Engineer has pointed out one of the main reasons why, in America, batteries have not made good records up to date. It is less a want of time than a want of devotion to this kind of apparatus on the part of the workmen that has caused a good deal of disappointment. Another reason is the method of employing the batteries. With their well-known energy American engineers have put themselves to the hardest task in order to make battery stations successful, and that they will finally succeed is not doubted by those who are following their work.

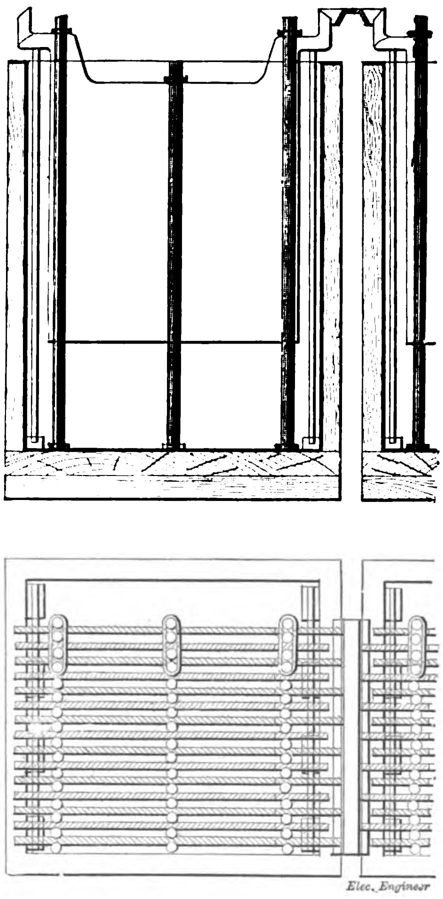


Fig. 5.—The Tudor Cell, Section and Plan.

"Gautherot" has made friends here, too, by his perfectly impartial and able article in The Electrical Engineer. Too much history has been repeated in America regarding storage batteries.

While struggling with this task, in Germany, and on the Continent in general, fruits have been gathered by those interested in storage battery work. It might be gratifying to those who are still in the battle to know that one factory at least, the Accumulator Works in Hagen, Germany, have in the last two years sold batteries amounting in value to $2,250,000, and have for the past three years paid 10 per cent. dividends. More than 2,000 batteries of various sizes have been sold during that time exclusively for lighting purposes. The success here accomplished may make it interesting to investigate closer the basis of this first financial success in this field.

The system adopted by the Works above mentioned is that of Henry Tudor, and is materially different from that of any other system in use to-day, not only in respect to construction of plates, but also in the method of operating, managing, and employing the batteries. The latter is not the least important point, and needs more elucidation.

The Tudor-plate.—As is well known, the positive plates are generally those whose short life has given such frequent trouble. The Planté plate with its electrolytically formed layer of active material has not yet been introduced in practice (as far as the writer is informed) and all the grids provided with active material according to Faure's process, have had but a short life in many cases. Mr. Tudor has, for the first time, adopted the golden mean; the positive plate shown in Fig. 1, is cast and represents a surface with small parallel grooves, while Fig. 2 gives its exact cross-section. A peculiar forming process first provides the cast plate with an active layer, and after this layer has been established, red lead is applied as a paste according to Faure's method. But this paste is not intended to provide for the capacity of the plate, except during its early life (between 6 and 10 months). It falls out of the grooves after that time and is just so calculated that the *Planté layer* which has been formed on the surface during that time *provides for the entire capacity* after the first year of use.

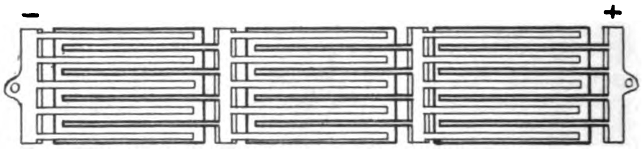


Fig. 4.—Method of Connecting Plates in Series.

The surface of the conductor or plate is larger than in other known plates, and owing to this circumstance, affords not only a considerable Planté layer, but also makes possible very large rates of charge and discharge. These plates are easily charged within 4 hours and discharged within 3½ hours; these are the *normal* rates which may be doubled for short intervals. This fact is both electrically and commercially valuable. The cost of the cells for discharge-current of 1,000 amp-hours is about 1,000 frs. ($200), while for especially heavy discharges it amounts to 500 frs. ($100). The great merit of this plate is that it has stood the service for lighting exceptionally well, and some millions of plates are in practical use.

The negative plate is constructed exactly like the positive, but in the future it is intended to use as negative plates, grids filled up entirely as in the Faure method, the grid being shown in Fig. 3. Special care is taken by the Tudor

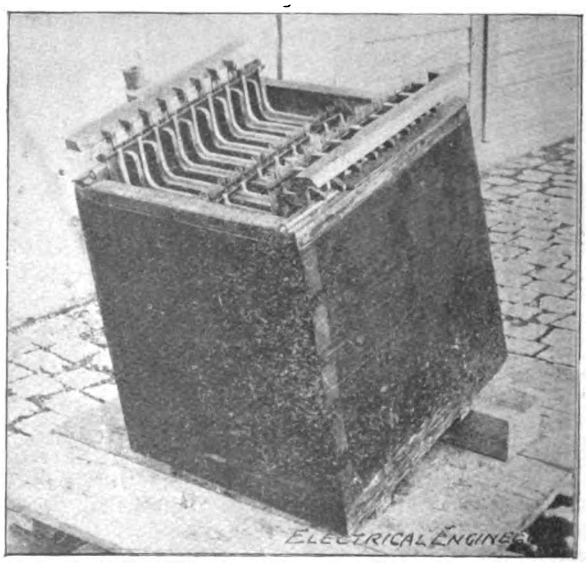


Fig. 6.—The Tudor Cell.

Co. in the building up of cells ; for larger cells, as used in central stations, the plates are shipped and the cells built up at the place of use. The usual way of putting up the electrodes in sections is not employed, but the plates are connected together in series as shown in Fig. 4. The distribution of the current to each plate is more equalized by this means, than by the usual method of connecting the plates in series. When such a series consists of a large number of plates it is found that the middle plates do not work so much as the outer plates. Fig. 5 gives a more accurate idea of how plates for large cells are connected.

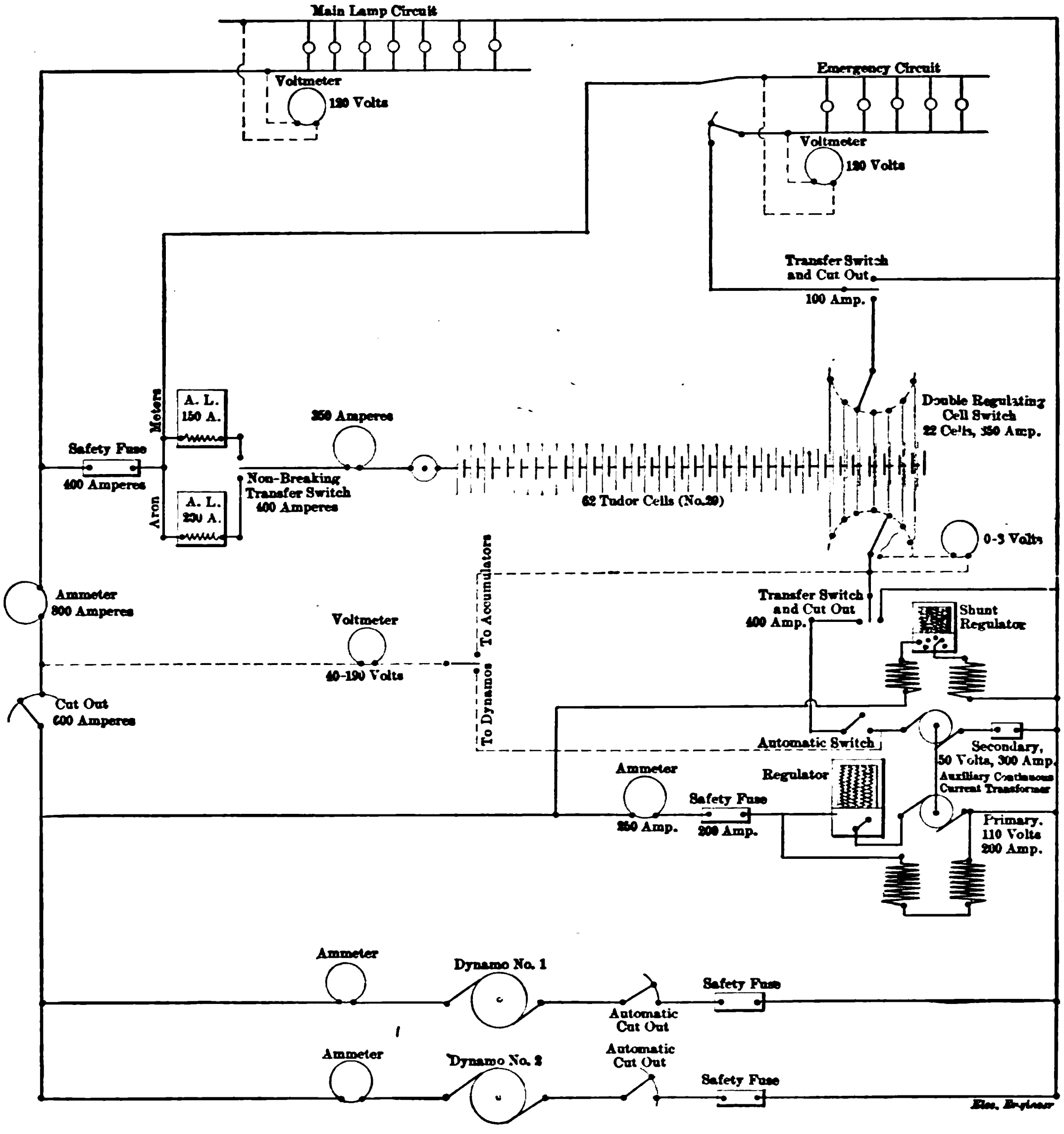


Fig. 8.—Diagram of Circuits of Tudor Accumulator Plant, Zürich, Switzerland.

Fig. 6 shows the present style and workmanship of the Tudor cells; it represents a cell of 500 ampere hours' capacity with 92 amperes charging and 110 amperes discharging current. Its weight, without acid, is 142 kilograms, and it contains 60 litres of dilute sulphuric acid (1.150 sp. gr.) Its cost is about 150 francs (about $30).

Fig. 7 shows a battery, placed in the theatre of the city of Zürich, Switzerland. This battery has a capacity of 1,650 ampere hours, taking a 287-ampere charging current and giving 350 to 400 amperes on discharging, at a potential of 115 volts. Its weight is 430 kilos, and it takes 175 litres of acid per cell. The cost of the whole battery was 25,916 francs (about $5,000).

The connecting of the battery with the dynamos (two dynamos each of 500 amperes and 120 volts) and with the circuits (including about 2,000 lamps) is shown in Fig. 8. The Tudor Company has made a special study of the art of connecting batteries. The principle here employed is to join the battery in such a manner that its valuable power of regulating comes into full play. In the present instance the difference of potential at the lamps during a performance with the sudden changes of light, is not more than 2 volts. During the performance, the battery delivers current, or takes up current, from the dynamos working with a constant power. The charging of the battery is performed by the use of an additional current transformer, which raises the potential of 120 volts up to 155–160 volts at the end of the operation. Automatic regulating devices and a self-regulating amperemeter and voltmeter are added, allowing a perfect and unfailing control of the charging and discharging work of the battery. The efficiency is guaranteed to exceed 75 per cent. (90 per cent. in ampere hours), and the working of the battery is guaranteed for ten years, a yearly payment of $400 being allowed by the theatre company to provide for subsequent renewal of the positive plates.

In case of emergency, this battery is able to provide the whole current for some minutes, and to provide half the number of lamps during the whole performance. A certain number of lamps is constantly used, run by a separate circuit connected to the battery, they being provided in case of a main safety fuse burning out.

It would require too much space to give details about the switchboard, this very important factor in the life of batteries, Fig. 8 merely showing a diagrammatic sketch of connections.

Very interesting and important are the rules which the Tudor Company lay down for the management of their batteries. *Charging* must be carried on even beyond the time when violent development of gases occur, and until *large* bubbles appear at the surface of the cell and at the same time all positive plates appear dark-brown or nearly black. *Overcharging does NOT hurt the cells* and at the end of each charging operation some minutes of overcharging takes place. The complete charging with a little overcharging at the end must be done, whether the discharge has been complete or only partial. The "wonderful amount of care and attention" by which the ENGINEER's informant was so much touched, consists in the following: At the end of each charge the attendant in charge has to go through the battery-room and see whether all cells boil regularly. That is done in a few minutes, even with very large batteries. Should there be a cell not boiling with the others, this cell is examined by means of a glow-lamp with a suitable reflector and the reason is soon found and the cause remedied. "Sitting up all night with it" would prove that the man in charge had not lived up to his instructions but left a cell short-circuited for weeks. In this case the nursing would not help much either, but new positives would have to be provided for that cell.

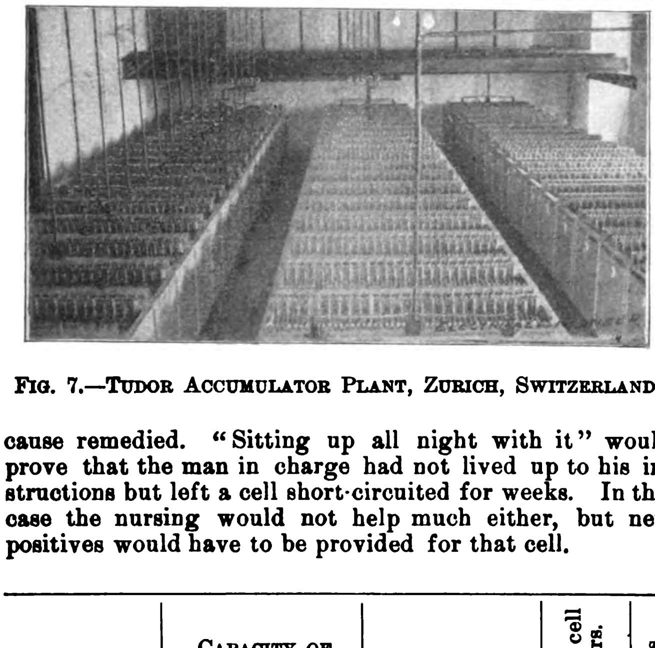


FIG. 7.—TUDOR ACCUMULATOR PLANT, ZURICH, SWITZERLAND.

Name of city.	Capacity of Batteries.		Discharge.		Capacity of one cell in ampere hours.	Number of cells.
	Ampere hours.	Watt hours.	Amperes.	Watts.		
1. Düsseldorf.	......	2,300,000	4,500	500,000	.....	840
2. Altona	11,500	1,224,000	2,400	264,000	2,300	280
3. Hamburg ..	11,500	1,179,900	2,400	264,000	2,300	270
4. Hanover ..	10,250	1,059,440	2,135	234 850	2,050	272
5. Breslau ...	15,200	1,628,832	3,170	348,700	1,520	564
6. Königsberg	5,280	621,984	1,104	132,480	1,320	248

LIST OF SOME STORAGE BATTERY CENTRAL STATIONS IN GERMANY.

The Tudor accumulator is manufactured by separate companies in Germany, Belgium, Switzerland, Austria, Italy and France. All these companies guarantee their products in the following manner: The company takes care of the batteries for from one to ten years and guarantees their good working by contract; the customer has to live up to the directions given for each battery and to pay between 5 and 10 per cent. of the value of the battery each year during the term of the contract. The yearly amount of payment depends on the size of the batteries, the kind of work performed by the battery, the distance from the factory, etc. Every three months, an engineer visits all the batteries to see how they are handled and how they are working, and makes his reports accordingly. Automatic devices are, if possible, made use of to control the management of large batteries. After 10 years of service, the company claims that the battery will still have the same capacity as it had at the beginning of its work. Experience with three batteries now seven years in operation seem to justify this claim. The reputation, and practical value of the Tudor accumulator for lighting purposes, has been established wherever it is known. Since some time also portable accumulators are manufactured by the Tudor Companies.

THE SUPPLY OF PLATINUM.

ACCORDING to the London *Journal of the Society of Arts*, there are strata of platinum at Bisserski, in the Ural Mountains, which can alone supply the total quantity of platinum required for the consumption of the world for many years to come. Platinum is found in Brazil and in the Cordilleras, where it occurs in hard serpentine rocks; it is only in the deposits of the Ural Mountains that the metal is found in grains. The richness of the sand in which these grains occur is represented by the figures 17 to 21 grammes of platinum to every 1,640 kilogrammes of sand. Stories are told in the Urals that, when the demand for platinum was insignificant and the price very low, the gold miners who found this metal in grains whilst gold seeking used to use the grains for shot instead of lead for firing at wild birds. All the platinum extracted from the Ural Mountains, after having paid a tax of three per cent. in kind, is sent to St. Petersburgh for treatment and shipment to foreign markets. Throughout the whole world only about 3,000—4,000 kilogrammes of platinum are annually used, but the consumption steadily increases.

AN ELECTRIC CRANE FOR THE BILBAO BREAKWATER.

AN enormous electric crane is to be used in connection with the work on the new $4,000,000 breakwater for Bilbao, Spain. It is constructed especially to manipulate the 100-ton blocks of artificial stone, which are made on the spot. It is built of stout braced steel framework resting on two four-wheeled trucks, the rails upon which it runs being about 18 feet apart. The car is operated by an electric motor taking its current from a trolley wire, the generator being a short distance away. The blocks are lifted by jointed hooks attached to the pistons of hydraulic lifting devices, the hooks clutching a block by means of two bands of iron put into position when the block is in process of manufacture. The blocks are then carried by the crane to the end of the wharf, where they are deposited in a boat and towed out to the breakwater.

ATMOSPHERIC ELECTRICITY.

For some months past M. Mascart has had, says *La Lumière Electrique*, some of his registering electrometers installed on the Eiffel Tower. He does not propose to obtain precise measurements at present, but is only endeavoring to find exactly what use can be made of the Tower for investigations in atmospheric electricity. Under present conditions the instruments are by no means favorably situated for observing the potential of the air; nevertheless, the values obtained are about ten times higher than those obtained at the Parc Saint Maur Observatory, a striking proof of the rapid growth of electric potential with elevation.

INCREASED COMMERCIAL EFFICIENCY AND HIGHER ECONOMY IN CENTRAL STATIONS.—I.

BY

J. H. Vail

Central stations for generating electricity for lighting or power purposes in connection with their systems for distributing and utilizing the same, must be regarded in the light of investments for capital, and their relative values gauged on the basis of dividends returned to stockholders. We may say that electric light and power, as a business enterprise, has passed the infantile stage, and is now regarded as a substantial money-making, dividend-paying investment ready for strong growth, and worthy of confidence backed by substantial financial support, when wisely located, properly equipped, and having the elements of commercial efficiency, permanency, and honest construction beyond question. It cannot be without regret that as a sincere and earnest advocate of the progress of central station business in its best form, I am forced to admit that the majority of such stations in the United States have not creditably withstood the analysis of time, and that a large number of them have been, are being or must be, reconstructed, largely improved, or totally abandoned for new stations in the near future.

It is true that, in many instances, these stations may be called "trial stations," and under this title have served to promote the electric lighting industry and create locally a strong craving for a better operating system, but we will never know how many of them have paid sufficient dividends to warrant their depreciation being rated at 10 per cent., 20 per cent. or 30 per cent., and this large depreciation means that in such instances sham work was originally done and now requires early reconstruction, to enable these stations to continue to perform their daily service with reasonably good economy.

The diversity of opinions heretofore, and even now, existing should be harmonized as to the usefulness and economy of high or slow speed engines, high or low steam pressures, substantial or sham construction, permanency of the business, earning capacity, etc. These have all been sufficiently tested to warrant judicious selections being made for new construction, and these ancestral stations have served a very useful purpose in demonstrating the values of certain types of boilers, engines, dynamos, systems and many other appurtenances, as well as features of mechanical and electrical engineering.

The present dilapidated condition of many stations cannot always be justly charged against the constructing engineer, as it is a well-known fact that in the face of advice to the contrary, the directors of numerous companies have advocated and insisted upon "Cheap John" construction; or in other instances, taken it out of the hands of a competent engineer, placing cheap and inexperienced men in charge, and are now only in justice reaping the bitter reward of such false economy. At other times, unprincipled competition has frequently demoralized the judgment of company officials inexperienced in electrical and mechanical engineering matters, thus resulting in an overwhelming amount of defective construction; the same even occasionally has been performed under the name of concerns having a reputation for good work.

The central station that from an investment standpoint, can at this time afford to continue to spend good money for poor construction because it is cheap, with the inevitable result of having a large percentage of its earnings devoted to constant repairs and maintenance, must be located in a territory exceptionally rich for revenue. It is easy to perceive that if most of the electric construction was of a more permanent character and had cost more money, the stations would have proven to be better investments because of reduced depreciation. Under ordinary circumstances, investors in electrical enterprises cannot be expected to view with equanimity frequent passing of dividends, or a large percentage of earnings annually expended on maintenance and repairs. Let us hope that where extensions or reconstruction are now contemplated, that in the interest of the investor it will always be decided that the work shall be performed honestly and in the best manner to secure permanency and durability, economy and high commercial efficiency.

Recognition must also be given to the fact that of many electric light companies now inaugurated throughout the country, the business of each was originally prospected and determined for a station of moderate size, delivering current within a limited area. The promoters did not realize the possibilities of the business. The present supply of current from these stations, will at once be regarded as very small when compared with the gas output in similar territory. How to promote further growth of the business of each local company, how to reach greater areas for supply and long-distance customers, how to produce the current for less initial cost, and how otherwise to increase the profits of electric lighting and power companies, are to my mind questions of large importance.

We must therefore prepare to do business on an increased scale, supplying from larger power stations electric current for all purposes to all classes of consumers over a practically unlimited territory. I believe these results can be achieved. I believe, also, that larger profits are to be secured by the combination of several methods, such as:

1. Reduction in coal consumption and economy of labor.
2. Higher commercial efficiency of plant and system as a whole.
3. More extensive use of electric light and motive power in districts or area already supplied from station.
4. Ability to supply current for general purposes from a single station over territory of largely increased area.
5. Consolidation of interests where small companies are unprofitably competing for business in the same town.
6. Larger investments, permanency in character of construction.
7. And last, but not least, judicious management of the company's business.

The experience of the past few years has been of peculiar educational value, and the engineer in charge of design and construction of new electric stations, must incorporate such a scientific and practical combination of economical apparatus that when united as a whole will give the highest efficiency.

And just here let us take a valuable and important lesson from the various types and combinations of apparatus applied in central station construction in European cities and towns. The business with them has not progressed as rapidly as with us; they have proceeded with more deliberation. In one feature particularly, they are in advance of much American practice and worthy of our emulation, that is, the first expenditures have been liberal and the initial cost has not been so contracted as to necessitate cheap construction. The general impression received cannot fail to be that durability and permanency have been fully cared for. In some exceptional instances, it appears that science and theory have obtained the upper hand over wise expenditure to such an extent that when the cost of primary generators, plus copper for long-distance transmission, plus motor-dynamos, plus storage batteries, plus copper and line work of distributing system for a small station of, say, 3,000 lights is compared with a direct station system, the investment in apparatus and system for the former, as against the latter, cannot show good net earnings.

Again, there are other stations and systems wherein very valuable features exist, which could well be selected and applied in our American practice, and thereby enhance the value of our investment by increase of dividends. By selecting the best points from foreign systems, and combining them with the most successful features of our own practice we cannot fail to improve over all predecessors. The great redeeming feature that must be a gratification to all persons interested in electrical industries in the United States, is that we have led the world in exploiting the same, and that regardless of the kind of construction, the aggregate of capital receives higher dividends per dollar invested, than can possibly be shown from European stations.

It must be perceived that extreme care as well as large experience is required, to enable the engineer to draw the line so fine as to properly protect invested capital on the one hand, and design a permanent, high efficiency station on the other, that will be exempt from criticism. My comments are not intended to deal with all the questions that would needfully be considered in connection with the above matters, but simply to treat on a few points and present for consideration some leading factors that must be kept in mind before any changes are finally determined upon. I shall therefore try to confine my remarks mostly to the question of generating plant.

ECONOMY IN FUEL.

One of the most attractive methods of increasing profits is to decrease cost of production. This part of the problem leads us directly to the coal pile, and for reduction in coal consumption we must look to our boilers, engines and other component parts of the steam plant. Central station managers and superintendents are having constantly brought to their attention different types of appliances and apparatus recommended as conducive to higher economy. There is a certain craze in the direction of applying these various appurtenances. Salesmen have all kinds of coal saving apparatus and other devices, guaranteeing abnormal percentages in savings. If a record were kept of the promised percentages of savings which these devices are warranted to secure, and the salesmen's promises held good, such record would show a coal saving of over 1ᴜ0 per cent., and the boilers instead of requiring fuel on the grate bars, would become coal producers. Therefore the promises must be largely discounted.

Engineers believe in the practical value of feed-water heaters, condensers, automatic stokers, damper regulators, compound engines, pipe coverings, etc., and yet we know that when all are combined in a single plant, they cannot possibly show collectively such a percentage of total saving in coal as has been claimed for them individually. It is unnecessary to enumerate the large list of miscellaneous appliances introduced and which are often possessed of individual merit. There are many that, while not actually effecting a saving in fuel, aid to secure the more perfect and satisfactory operation of the plant or reduce labor of handling, and must therefore be judged of much value from this standpoint. I would not for a moment discourage the use of these, but rather advise the judicious selection of the best, with the anticipation of a reasonable saving of both fuel and labor as the benefit derived. We should also be cautious in the adoption of too much apparatus of the automatic or self-operating character, lest by lack of necessity for personal care we tend to diminish the vigilance of the engineer, and thus lead to disastrous accidents, because of the automatic device getting out of order. unnoticed.

The application of any special type of engine, boiler or appliance, must be solely on its commercial and economic value for the specific station, system, and local conditions surrounding the same. Expensive fuel will warrant the use of numerous economic devices often requiring large investment, while the same expenditure could not be deemed judicious where fuel is comparatively cheap. Again, in stations of medium capacity, say, from 2,000 to 5,000 lights, there are chances that the interest on the capital expended for higher economy apparatus to obtain better coal economy, may be more than the money value of the coal saved ; therefore, the necessity of competent engineering advice, guided by which should be made the intelligent combination of such apparatus as will secure best economy, so that the results, when compared, may show increased net profit over and above the interest on extra capital invested.

Better fuel economy is to be secured by the judicious application and combination of improved types of apparatus. We must faithfully hunt out and stop every source of waste and apply all reasonable methods to avail of every heat unit, and thus save the steaming value of of every pound of coal. The present fuel consumed in central stations may be assumed as ranging from 3 to 8 lbs. of coal per horse power hour; the higher economy which we may hope to attain may be set at 1.7 lbs. with compound condensing engines, 1.5 lbs. with triple-expansion condensing engines, and 1.3 lbs. with quadruple expansion engines. The coal required for pumping and other incidental service is included.

Briefly on the various points as to how economy of fuel is to be secured, I will say that we must thoroughly investigate the conditions surrounding and covering the location of a proposed central station plant. The first cost of coal, its delivery in the station, the steaming qualities of the coal and the percentage of refuse, must all be carefully ascertained. The plant must incorporate boilers of the highest evaporative efficiency, also such appliances as will secure the best results from the coal obtainable. Such a system of piping as will permit a free delivery of steam from boilers to engines; engines of such a type and economy as will give the highest results from steam used. Condensers should be applied, where conditions will permit, feed-water heaters, covering to reduce surface condensation, and appurtenances to save and utilize every unit of heat.

Another matter which is receiving but little attention in central station practice is the absence of any method for utilizing the heated air of the boiler and engine-room as hot-air supply to the furnaces. A large amount of heat is developed that is generally wastefully disposed of by free ventilation at the ceiling of the boiler-room. This heated air can be availed of as a hot-air supply to the furnaces with some percentage of economy, and at small cost can be raised to a higher temperature by additional circulation. The minor sources of wasted heat, if carefully followed up and remedied, will, when all summed up, result in a considerable net saving in fuel. All of this can be accomplished at small cost, and improved economy, still securing ample fresh-air ventilation.

HIGHER STEAM PRESSURES.

Where the construction of a new station is contemplated it will readily be recognized that the boilers, steam piping and other appurtenances connected with the steam plant, can be arranged to carry the higher pressures required for operating compound condensing or triple-expansion condensing engines; but where the reconstruction of an existing station is intended, it is of great importance that a thorough inspection be made of the boilers, steam piping and all adjuncts thereof, with a view to ascertaining whether all are of sufficient strength and in serviceable condition to carry safely the higher pressures required. Pressures of from 80 to 100 lbs. should be used for compound-condensing engines and from 140 to 160 for triple-expansion engines.

For quadruple-expansion engines, we must calculate to carry a steam pressure of 200 lbs. per square inch. To do this, we must have boilers, piping, fittings and other appurtenances ample in strength for the higher pressures required. Efficient and durable lubricants must be secured to stand the increased temperatures; thus far, these lubricants cannot yet be considered as satisfactory. When these difficulties are overcome, we may anticipate the use of quadruple-expansion engines in stations of exceptionally great capacity, where very heavy constant loads can be carried for many hours. We must, however, be content to wait and see the engine developed and the station reach an output where the constant large load will warrant the extraordinary investment.

A NEW STANDARD BALLISTIC GALVANOMETER WITH VARIABLE SENSIBILITY AND WITHOUT "DRIFT."

BY

Elmer G. Willyoung

THE galvanometer which I am about to describe is the product of considerable study and careful tests. It became necessary a number of months ago for me to design a good ballistic galvanometer, and several were built and experimented upon in order to obtain the best operation and results. A great many tests were also made upon the instrument in the laboratory in connection with routine work, the instrument having been used in every day practice by various persons for a number of weeks. This, of course, is one of the hardest kind of tests to which an instrument could be subjected. The law of deflection, the leakage, the decrements of damping with coils open and closed, with coils short circuited and in series with various resistances, were all obtained. Various modes of suspension and of constructing systems were tried; in particular a considerable time was devoted to the study of different methods of varying the sensibility of the system, and some important conclusions were drawn.

The instrument which has been finally produced as a result of these various tests and experiments is shown in the engraving, Fig. 1. I will first call attention to the general plan of the instrument. The coils are two in number and equal in size; they close upon the magnetic system, which hangs in a diameter between them, and are supported upon highly polished and corrugated hard rubber pillars. These pillars are 2$\frac{7}{16}$ inches high and, since the corrugations are sides of equilateral triangles, they are equivalent to plain pillars of just twice the surface, or about 5 inches high; the surface resistance to leakage is, therefore, very great. Upon the rubber pillars are brass rods joined at the top by a cross bar which carries the torsion head and its suspension. The suspension is, when in position, a trifle over 2$\frac{3}{4}$ inches long. The torsion head is divided into 15 degree divisions and by its means the coefficient of torsion of any suspension may be quickly obtained.

The coils of this instrument are of the graded type, the number of changes of wire which have been made in the grading of the coils being five. The exact position of each of these various sizes has been determined by mathematical calculations working from the actual data of commercial wires and the best results in the way of thickness of insulation which we have been able to obtain. A special frame was used in the winding of these coils, as with all coils put on galvanometers made by Messrs. Queen & Co. This frame enables us to accomplish the grading correctly and with great facility. The core of this frame is of steel of a very small diameter so that very little of the valuable space at the centre of the coil is lost. The sensibility of these graded coils, wound according to calculation, was to the sensibility of coils wound in the usual manner as 9 to 4.

The clearance between coils in this galvanometer was made but $\frac{1}{20}$ inch, leaving just room enough for the system to turn in. The instrument has been so made that the coils may be connected together by means of light flexible connectors, R seen in the engraving, so that they may be used either singly, in multiple, in series or differentially. In case a still greater range is desired, the coils may be removed and other coils substituted, they being made strictly to gauge and interchangeable. The binding posts screw into little studs attached to the coil's end, and are surrounded by light rubber washers D, where they pass through the case. These washers prevent dust and dirt getting inside the case when the instrument is not in use but are withdrawn when it is desired to use the instrument, so that the binding posts are always insulated from the base by the hard rubber pillars.

Levels have been left off the instrument as the writer has come to the conclusion that the level is of no practical use to the majority of those having to do galvanometer work, the instrument being usually leveled up until, by inspection of the mirror, the system is seen to swing freely. In order to quickly inspect the system the coils are pivoted so as to be easily thrown open by merely removing the binding post rods and raising the milled screw clamp V.

What I want to call particular attention to in this instrument, however, is the method of controlling which is employed. This method of control is, I believe, new and is applicable to all instruments in which the moving system is made up of one or more magnets. It is the invention of Mr. Edwin F. Northrup, of Messrs. Queen & Co's. laboratory, and is, I believe, one of the most important additions to galvanometer practice which has been made for a long time. The improvement consists in a means of varying the sensibility of the instrument within the widest limits in an exceedingly simple way and in a manner which entirely does away with some of the annoying inconveniences and sources of inaccuracies which have been experienced heretofore when using instruments of this character. As is well known, the usual method of varying the sensibility of instruments of this type is by neutralizing the earth's field to a greater or less extent by means of the exterior "control magnet" attached to the frame of the instrument. This method of varying the sensibility has been the source of a difficulty, the cause of which has not always been comprehended and which has been exceedingly annoying and has caused many inaccuracies and delays in work. This trouble is familiar to most galvanometer users as the "drift" of the needle.

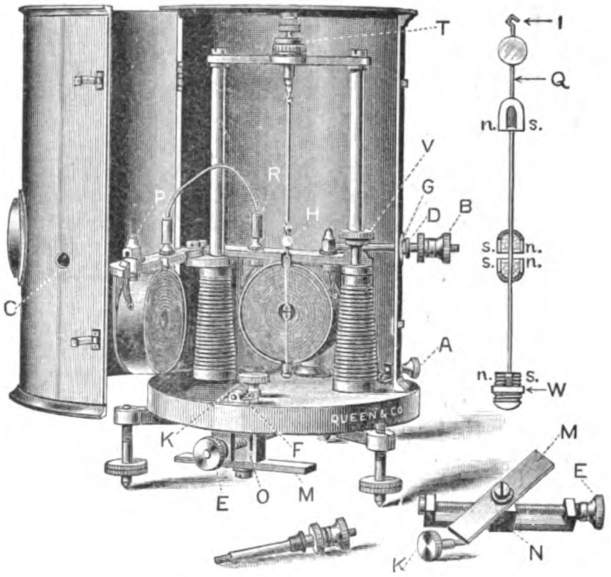


FIG. 1.—NEW STANDARD BALLISTIC GALVANOMETER.

Let us conceive a case of a system composed of two sets of magnets B and D, Fig. 2, the upper set composed of four magnets with their north poles pointing in one direction, and the lower set composed of three magnets, of the same length as the upper set, and with their poles pointing in the opposite direction: this combination is known as an "astatic" system since the controling force of the earth's field is only the difference of the magnetic moments of the two systems. In the case supposed, the upper set "controls" and the N poles of the upper system will point to the north. If now we wish to make the system still more astatic we weaken the earth's field upon the upper needle be means of a control magnet suitably placed near it. We now have the magnetic system subject to the influence of two fields, one, the earth's, and the other the field of the control magnet. We may represent these two fields in strength and direction by lines suitably drawn; let us also suppose that these fields are placed to oppose one another but with planes not rigidly parallel. Fig. 3 shows this with A B representing the earth's field in strength and direction, and A C that of the control magnet. Completing the parallelogram, we obtain A D, which represents the resultant field in direction and intensity.

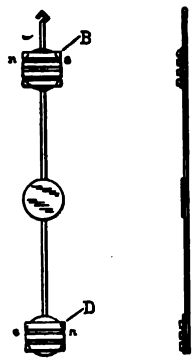


FIG. 2.

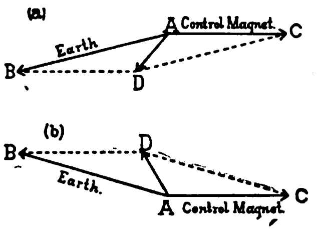


FIG. 3.

Let us suppose now that the earth's field slightly changes in direction as is shown in *b*, Fig. 3. The resultant now points nearly directly opposite to its first position, and though the earth's field has moved through but a small angle, we see that the resultant will have moved through nearly 180 degrees, so that the slightest shifting of the earth's meridian causes an intensely magnified movement of the resultant.

There are none of us, probably, working with galvanometers, but who have experienced this annoyance. After some time spent in adjustment, we finally get the mirror nicely to zero, when in a few moments we look again and find some other number on the scale before us, and if we keep our eye at the telescope it is possible to see the mirror of the scale moving across the field of the telescope. These changes are obviously greater in proportion to the sensibility of the instrument; the mirror is never still, going one way and then another. The fluctuations are, of course, more pronounced at some periods of the day than at others, owing to the fact that the earth's meridian is changing at a more rapid rate at different times during the day. This difficulty necessitates a frequent adjustment of our instrument and causes a great deal of delay in the attaining of results.

By the device of Mr. Northrup's, all the annoyances of "drift" are eliminated, the instrument is rendered much more certain in its indications, besides being less expensive to construct. Reference to Fig. 4 will show the principle of this device. At (*a*) is an ordinary horse shoe magnet at the bend of which is a bar of soft iron A B; the distribution of the lines of force is practically unaltered by this bar. In (*b*) we have the same magnet but with the bar moved about half way up towards the poles; the lines of force are now considerably deformed and many have been drawn down so as to pass through the soft iron armature. In (*c*) the same armature has been pushed up to the very poles and almost all the lines are now passing through it, the magnet thus being short circuited and made about as ineffective, as regards its external field, as would be a mass of soft iron of the same shape. Now let us look at the magnet system shown to the right in Fig. 1 which represents the system used in this instrument. The system is seen to be composed of four "bell" magnets of the well known Siemens type; the upper and lower have their poles turned in the same direction, while the centre magnets have their poles also in the same direction but opposite to that of the outside magnets. The upper and lower magnets thus make up one set of an ordinary astatic system and correspond to the set B, Fig. 2, while the centre magnets correspond to the set D.

The outside magnets are, as will be noticed, slightly longer than the inner ones and will, consequently, if all are magnetized in practically the same way, be the stronger and will "control" the system. If now we weaken one or both these outside magnets their control will be lessened and the period of the system will be increased until finally the influence of the inner magnets will begin to predominate and the system will swing round through 180 degrees. The means by which this weakening is accomplished are in this instrument very simple. The lower magnet has cut upon it a very fine screw thread, and upon this thread is fitted a narrow and light ring of soft iron, W. When the ring is at the bottom of the magnet its influence is nil; if we desire a greater sensibility we simply screw the ring up until this sensibility is attained. In order to do this easily the system is attached to the fibre by means of an exceedingly small hook, I, and may readily be removed by simply lifting it off with the aid of a small pair of forceps, when the ring may be moved a trifle, the system replaced, and the vibration period observed; in practice, all this can be done in a very few minutes.

It might be objected that in thus short-circuiting this outside magnet we lose a portion of the deflecting moment of this magnet which is, of course, acted upon by the coil. This is true, but the loss is very small, the effective couple upon these outside magnets being vastly less than that of the inner. The best proof, however, is the result, and some of the results obtained with this instrument are given below. Using the old method of control, that is, an exterior control magnet, we had:

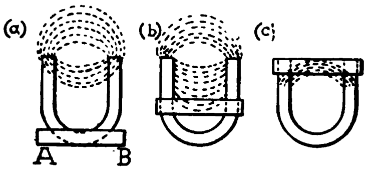


FIG. 4.

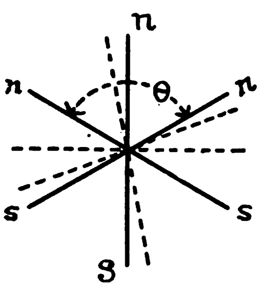


FIG. 6.

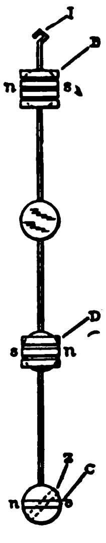


FIG. 5.

Period (single swing)	$4\frac{17}{25}$ seconds.
Mean deflection $\frac{1}{5}$ M. F. at 1.44 volt	100 mms.
Drift in 5 minutes	2.5 mms.

With Northrup's Method:

Period (single swing)	$11\frac{1}{10}$ seconds.
Mean deflection $\frac{1}{5}$ M. F., at 1.44 volt	211.5 mms.
Drift in 5 minutes	Inappreciable.

And making it still more astatic:

Period (single swing)	21.6 seconds.
Mean deflection $\frac{1}{10}$ M. F., at 1.44 volt	237 mms.
Drift in 5 minutes	Inappreciable.

The large vibration period of over 40 seconds for a complete swing obtained without "drift" is extraordinary in my experience. It may readily be made very much greater, however, and the instrument correspondingly more sensitive by this method. The ring, instead of being screwed on, might, of course, be held on by its friction. Indeed, in the first set constructed, the ring was so made. It may, of course, also be applied to the upper instead of the lower magnet, or, indeed, to both, if desired. It may also be applied to the orthodox system in a variety of ways; for instance, one of the sets of magnets of an ordinary Thomson system might have a little sheet of iron arranged so as to slide up and down on the shaft of the system, thus short-circuiting, more or less, the magnetic lines of force of this particular set of magnets; or we might extend the shaft of the system on below the lower pair of coils, and here place a single small magnet acting with one of the regular sets of magnets of the system, and thus controlling the system. On the back of this might be a little piece of soft iron of about the same size as the magnet, and pivoted so that when parallel with the magnet the lines of force of the latter would be almost completely short-circuited, but when perpendicular to the magnet it would be very little influenced. This mode of application is shown in Fig. 5, the dotted lines indicating the little piece of soft iron.

The system used in these extremely sensitive galvanometers of the Thomson type is required to be so extremely light in order to be efficient that the slightest additional weight is to be deprecated; the actual weight of the systems as made in the best instruments being slightly less than 350 mgs., including the mirror. I have not yet, therefore, succeeded in making a system embodying the improved method of control which is satisfactory to me. The instrument shown in Fig. 1 has, therefore, an exterior control magnet, M, used only when the light system is required; when used for ballistic work this magnet is entirely removed from the instrument by merely loosening the milled head K.

As regards the construction of the system used in this ballistic instrument, considerable pains have been taken to work out one thoroughly adapted to the requirements; its moment of inertia is extremely large, the little magnets (Fig. 1) being filled with lead in order that this may be so. The magnets being cylindrical there is minimum damping due to air friction. The magnets are threaded upon a little quartz rod Q; the weight of the whole system is 4½ grammes. Quartz is used for a support for the system, rather than glass or metal, on account of the set of the latter material.

Experience in galvanometer construction has taught that the well-known set in glass and metallic wires is productive also of "drift" if they are used as supports of a system of magnets. This is illustrated by Fig. 6, where A B and C D represent two magnets of equal length, placed one above the other on the shaft so as to make up an ordinary astatic system. The magnets, as seen here, are at a slight angle to one another, it being practically impossible to place them in the same plane; the resultant of these two magnets must, of course, lie within the angle θ. If now there is any set in the shaft, upon which these magnets are mounted, which is slowly working itself out, the relative position of these two lines will change and the plane of the resultant will consequently be shifted. This, of course, will cause "drift" of the needle.

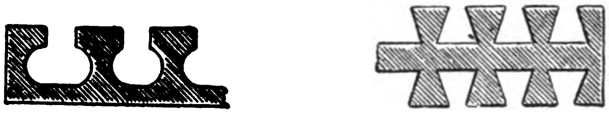
The fibre intended for use in the instrument is a very fine quartz fibre, having soldered to its ends exceedingly small hooks corresponding to the small hook on the torsion head and to another one on the system itself. In this way the system is very easily removed either for adjustment of its little control magnet or to be replaced by a light system for ordinary work.

A BIOGRAPHICAL SKETCH OF THE KHOTINSKY ACCUMULATOR.—VI.

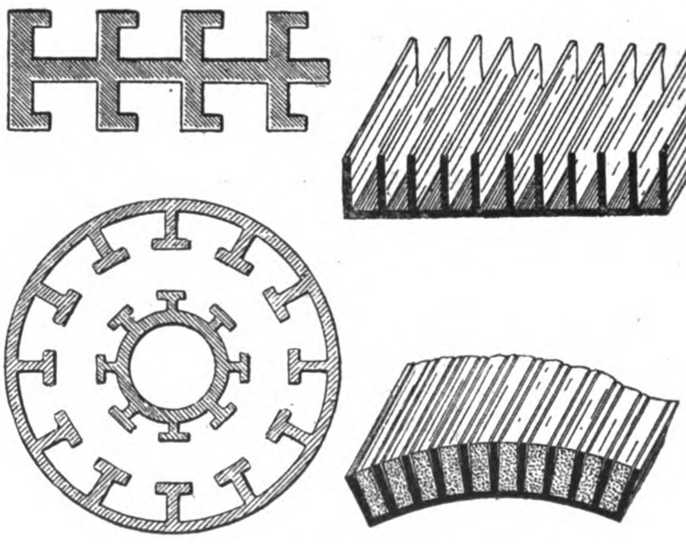
BY

Capt A. de Khotinsky

In January, 1885, I went to Cannstadt with six cells of my battery, which had been made for this station in order to have them tested by Professor Dietrich. From the report of Professor Dietrich and especially from the successful results of my horizontal accumulator in the block station at Rotterdam, my company now found it time to go before the public with the accumulator. The company, aware that for years to come the question would be the improvement of accumulators, saw that they would need security for the durability of the accumulators without risk to themselves. An order for a station for arc and glow lamps followed from the Frankfurter Company in Frankfort-on-the-Main, which was put in operation in the winter of 1885 and fed 230 glow lamps and six arc lamps.


FIGS. 18 AND 19.

In November, 1885 I went on my company's order with six cells of my horizontal accumulators to Vienna. The Imperial Continental Gas Association in Vienna had undertaken the electric lighting of the Imperial Court Opera by accumulators. Herr Albert Ritter von Obermayer, Imperial Major, professor at the Technical Military Academy, was charged by this company with investigating my accumulators. Several orders from different countries in Europe were now received and filled as a result of this investigation.


FIGS. 20, 21, 22 AND 23.

Up to the winter of 1885 I used flat wooden trays, the insides of which were lined with canvas coated with a preparation of tar. It was always impossible for me to procure adequate trays of glass or other insulating material which at the same time would be acid proof. In Rotterdam these wooden trays proved very good, but in transporting them the shaking loosened the coating of tar and leakage ensued. I remedied this by lining the wooden trays with lead and placing between them and the lead a preparation of tar. To insulate the positive electrodes I put them in small flat troughs of hard rubber, while the negative electrode rested on the lead tray, which also served as the negative electrode. The small hard rubber troughs used for holding the positive electrodes were expensive and had the disadvantage of breaking as soon as the positive electrode commenced to expand.

During the construction of the first battery of horizontal accumulators, I had, as the most convenient construction, and also for possibly augmenting the capacity, devised an electrode skeleton of pressed lead, with a projection at the end of each rib to prevent a falling out of the filling material from the middle ribs and the framework walls, as shown in Figs. 18, 19, 20, 21. Applications in all countries for a patent on this construction had already been made in the spring of 1885, but I had great difficulty in finding a lead factory which was able to deliver to me the described skeleton. Finally, however, I succeeded in getting at least one skeleton delivered like that shown in Fig. 22, and at once used this to dispense with the small hard rubber troughs while, for the sake of insulation from the lead lining, I put them on paraffined sticks. But experience soon proved that a one-sided electrode curved like an arch by the expansion of the filling, as in Fig. 23. After several unsuccessful attempts I finally succeeded in finding a little lead factory in Holland which was able to deliver to me an electrode skeleton of pressed lead, such as I wanted. This first electrode skeleton is represented in Figs. 24, 25, 26 and 27. In December I could form accumulators of large capacity up to 600 ampere hours per element, with the assistance of this electrode, as in Fig. 28.

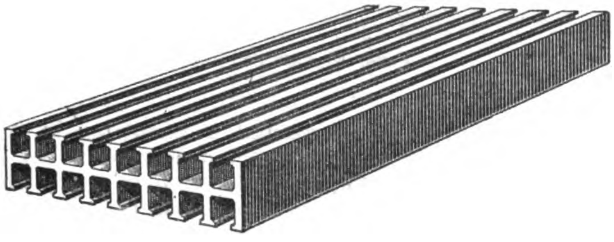
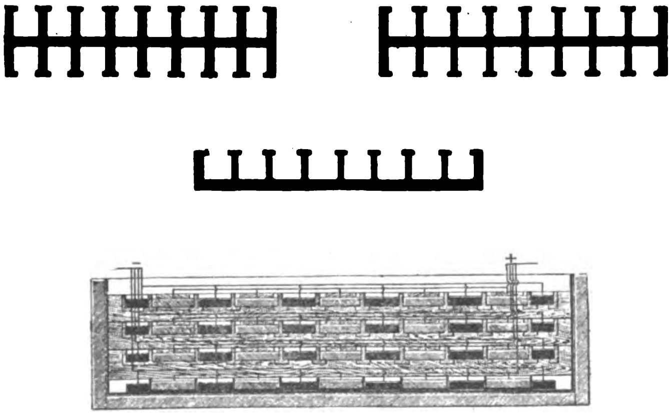


FIG. 24.



FIGS. 25, 26 27 AND 28.

In the spring of 1886, the Electro-Technic Factory, at Cannstadt, commenced to use my accumulators for lighting railroad cars in accordance with my system, and a growing interest in the accumulators appeared in Germany. In the meanwhile I had established a factory in Rotterdam, as the sale of my glow lamps had greatly developed.

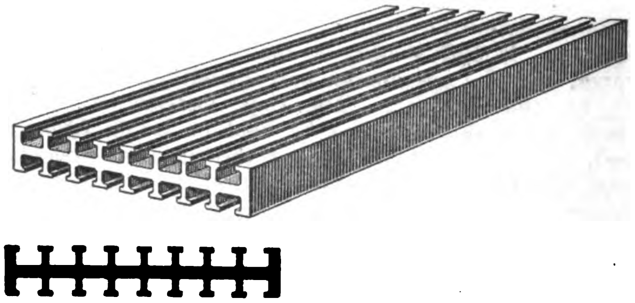


FIG. 29.

As their good quality was now well recognized, my company decided that I should give my whole time to the manufacture of the lamps, and I therefore gave up my manufacture of acumulators and turned it over to the firm of Gottfried Hagen, in Cöln. By taking these measures I gained also the savings of freight and import duties from Holland to Germany.

In the year 1887 I was charged with the erection of a new block station in Neue Friedrichsstrasse W. 37, in Berlin, which had to be constructed for Mr. L. W. Schöffer. It was determined, in this station, to prove that my glow lamps of high voltage (160 volts) and also the combined system of accumulators with dynamos was capable of supplying a complete system of distribution and could compete with gas distribution on every point. The project included 1,200 glow lamps of 160 volts and 16 c. p. It was required that in case of necessity the accumulators should be able to supply with current 1,200 lamps for only three hours and that the battery in normal action must deliver in six hours its whole capacity of 1,200 ampere hours. Up to this time I had only made cells which could discharge their whole capacity for eight hours. I could easily have solved the problem by slower charging and discharging of these cells (Type L), as is still done at all other accumulator factories, but I aimed to avoid the inevitable waste of material connected with this course and therefore sought to work out a new electrode for rapid charging and discharging (Type R). To reach this result, I had only to resume the experience of relative enlargement of the contact surface of the electrodes, already made, and according to these principles I made a skeleton as shown in Fig. 29 for a positive electrode and in Fig. 30 for a negative electrode.

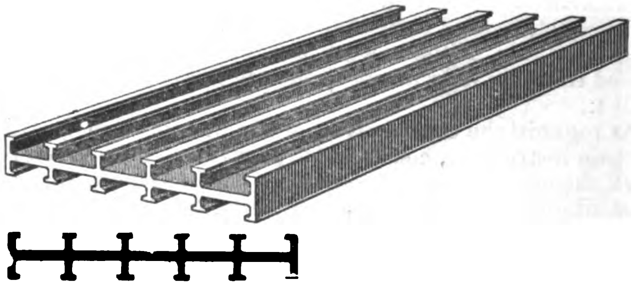


FIG. 30.

EXHAUST STEAM HEATING AT CEDAR RAPIDS, IA.

THE AMERICAN DISTRICT STEAM COMPANY, of Lockport, N. Y., have completed about a mile and a half of mains for the Cedar Rapids Electric Light and Power Company, and now have steam on the line. They are already heating over 1,000,000 cubic feet of space with three pounds pressure in the heating mains.

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VOL. XIV. NEW YORK, NOVEMBER 16, 1892. No. 237.

In working for discovery, it is requisite to experiment first and then seek the interpretation.—John T. Sprague.

CLOSING THE WORLD'S FAIR AT NIGHT.

ONE of the most important questions, lately, in connection with the World's Fair, has been that of closing or opening it at night time. It is stated that the management proposes to close the Fair at 7 p. m. each day, putting into force a rule that has been adopted provisionally, among others, by the National Commission, having to do with the police regulations of the grounds, etc.

If there is any likelihood—which we can hardly believe—that the Fair will close at the hour when it can be made most attractive, we beg to enter at once our most emphatic protest against any such proceeding; and, if it is insisted on, we advise dynamo and lamp manufacturers to abstain from exhibiting. In Chicago, the argument is made that it will prevent the local workingmen from seeing the Fair, as their spare hours are mostly in the evening. This may well be, but such a view is simply local. Early closing of the Fair would be a most serious matter for the workingmen from all parts of the Union, whose leisure is scant, whose spare dollars are very few, and who will not be at liberty to spin out their visit to Chicago over several days. If the Fair closes at 7 p. m., it means to them the loss of at least three solid hours daily, with the sacrifice of much of their intellectual pleasure and technical profit.

But there are other grave considerations. It is estimated that the electrical exhibits will run into millions of dollars in value, and the largest part of this money will be spent on apparatus for light and power. Are we to believe that this apparatus is to be idle just at the moment when it can best illustrate its benefits as an addition to modern means of convenience, comfort, economy and beauty? If so, electrical manufacturers have been fooled and played with. It would be interesting to know where and exactly why such an idea as this originated, of shutting down the electrical exhibit just when it would be most effective.

Moreover, the Fair itself will be most brilliant as a night spectacle. Even if all the buildings were not kept open, there would be some to which access could be given, and which everybody would reserve as "choice mouthfuls" for the remaining hours of a memorable day. And then the grounds and lagoons would be at their best under the arc light, with bands playing, and the wonderful electric fountains illustrating anew the birth of light itself.

It seems to us that the management, if serious in such a proposition, forget the obligations into which they have entered. Many of the concessions awarded have, to our knowledge, been based by the lessees on calculations that included several hours after sunset. Besides that, a great many of the State buildings have made special plans and arrangements for artistic electric illuminations. Are we to understand that this expense has all been incurred for nothing, on a deliberate misrepresentation? Of what use would these decorations be in the day time? The Fair authorities have themselves also gone to enormous expense for electric lighting. The contracts for lighting include about 100,000 incandescent lights for the buildings and about 5,000 arc lights for the grounds. A huge generating plant has also been ordered, and much of the work has actually been begun or even done. This represents more than $500,000 of public money that might at least have been saved if it was not intended to keep the Fair open after 7 p. m., for very few, if any, of those lights would be needed in the daylight hours between May and October; and it certainly would be sheer and criminal extravagance to make such an outlay merely for half-a-dozen special spectacular evenings. One leading object of the Fair authorities, having made such liberal provision of current, should, on the contrary, be to stimulate the larger exhibtors to new and original displays of decorative electric lighting, and thus to emphasize the great fact that light has to-day become, equally with color and drapery, an element of the beautiful and æsthetic.

We feel very much like saying that, after all, this is just what we feared. When Chicago first got the Fair, and a building was devoted to Electricity, and the air was full of enthusiastic talk, it really seemed as though the world was going to witness the illumination of all Lake Michigan, backed by a display of about ten billion lights in the Fair buildings and grounds. Gradually and gradually, the dream has been sobering down into a dismal reality, and now we find that there is virtually to be no electric illumination at all. Once more, we protest. In the name of the electrical exhibitors; of the various concessionaries for all sorts of privileges sold at fabulously high prices; of the authorities who have ordered elaborate illuminations for State buildings; of the workingmen and modest wage earners of America; and in the name of all others interested in seeing the Fair, and in getting quickly back home again—we protest. If the Lord Almighty walked in his fair Garden of Eden in the cool of the evening, we want to know why his creatures are to be forbidden the same privilege in the fairest Garden that American genius has ever laid out.

UNIPOLAR DYNAMO CONSTRUCTION.

BY

Edward C. Boynton, Jr. M.E.

It appears to the writer that the recent articles in The Electrical Engineer upon "Twisting Magnetism" while they may, or may not, have succeeded in explaining that interesting phenomenon, have done considerable towards "twisting" the fundamental laws governing electromagnetic induction.

Suppose one were busily engaged in trying to devise a unipolar dynamo, and eagerly searching for "points;" where would he be after reading the various opinions recently expressed? One writer supports his own theories, another believes exactly the opposite. The different interpretations of these "familiar laws" are astonishing, and this is probably one of the principal reasons why we do not get a successful high-voltage unipolar machine. The interest in the so-called unipolar dynamo is far greater than is generally supposed. It is probably not an exaggeration to say that nearly every electrical engineer, at some time has turned his attention to this class of dynamos with the hope of devising one that is commercially practicable.

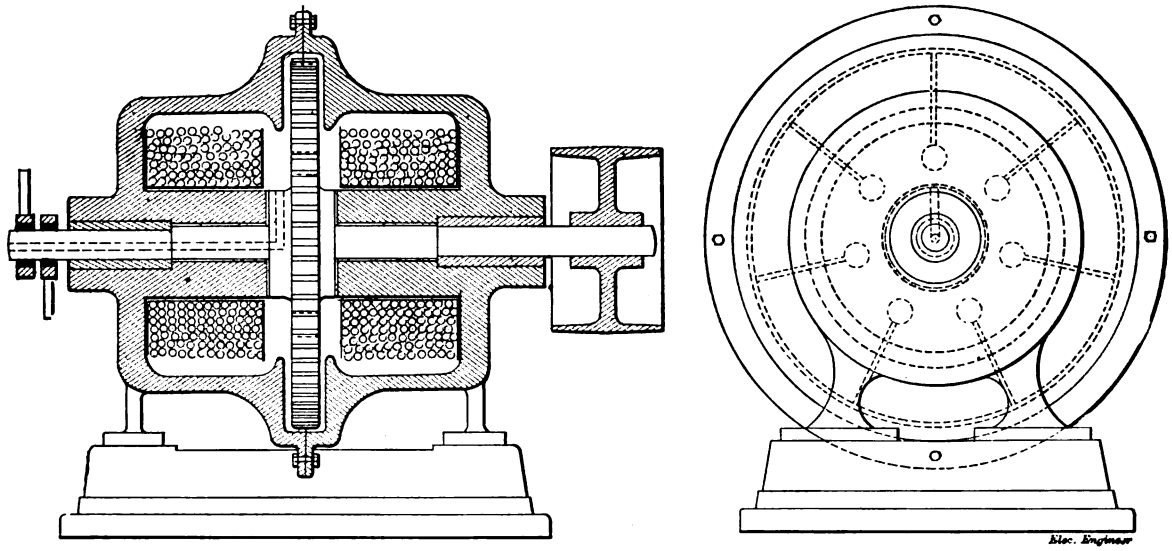
Very little has been written on the subject heretofore, and it is almost impossible to get information concerning the experimental work that so many have devoted to it. In consequence, many failures are probably being repeated. In order to intelligently study the unipolar problem one must be able to correctly interpret some of the laws governing the relation between the electric current and a magnetic field of force, known as induction. These laws are laid down by various writers with more or less lucidity, and it is difficult at times to keep from being misled by their language.

The theory of the generation of current in a unipolar dynamo is exactly the same as in a bipolar or multipolar machine. The statement in a recent letter to the Engineer to the effect that the current in a bipolar dynamo is due to the "increase and decrease of the number of lines of force passing through the circuit of which the moving conductor forms a part, etc.," the writer does not believe. That the statement is founded on one of Prof. Thompson's laws every one is aware, but with all respect to that eminent authority, from whose books the writer has gained more information than from any other, this law seems at times to be superfluous, especially when the generation of current can be explained by another law with far more clearness.

If a conductor be moved at a constant speed through a perfectly uniform magnetic field, at right angles to the direction of the lines of force, a perfectly smooth uniform current in one direction will be generated in the conductor if its circuit be closed. If the density of the field of force be not uniform, but is more dense at one point than another, the current in the conductor will be undulating in character, but will flow in the same direction at all times. The whole problem of the unipolar dynamo is to use a number of these conductors, and to close their circuits so that they will be all in series.

The interesting part of the problem is to connect them in series *outside* the field of force. If this is not done, the lines of force will cut the same circuit a second time, causing a reversed current, and thus completely neutralizing the current in the circuit. There are at least two methods of making these connections outside the field, and the writer regrets that he is not at liberty to give them at present.

Almost the only law necessary to constantly bear in mind in studying a unipolar dynamo or in trying to "wind" the armature for one, is that which is commonly illustrated by the thumb and two adjacent fingers of the right hand, pointing in three different directions at right angles, showing the direction of the line of force, the direction of motion of the conductor, and the direction of the current induced in the conductor. Probably the better illustration is that representing the three co-ordinates of space, for one can be made out of cardboard and the circuit of the armature conductors followed by it in such a manner that it can be readily seen whether the current will reverse at any point in the circuit.



Figs. 1 and 2.—The Boynton Experimental Unipolar Machine.

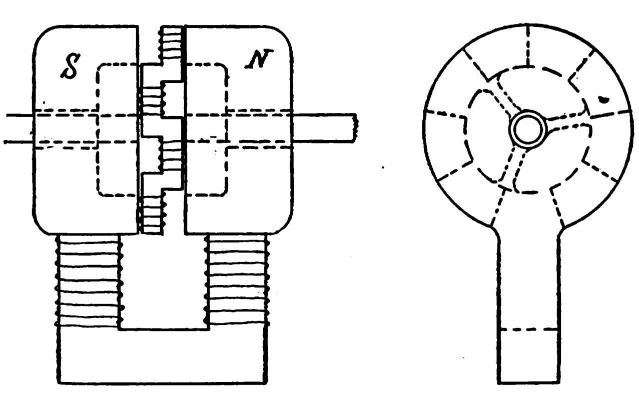
Magnetism certainly will not "twist" in the sense the writer of the original article meant. Why it will not, some one else must explain. If the core of a bar magnet be rotated about its longitudinal axis, no matter whether the energizing coil be rotated with it or not, the lines of force are practically stationary and do not rotate with the core. If the armature of an ordinary bipolar machine, "D" type, be left bare and the wire, instead, be wound around the pole-pieces, outside and through on the polar surfaces, parallel to the shaft, then if the armature be rotated and magnetism *would* twist, the lines of force would stick out around that armature like the bristles on a hog's back and would cut the conductors on the pole-pieces beautifully. But on the contrary, it is well known that the lines of force through that armature are stationary, and rotating the armature does not move them.

Although we do not know exactly what "lines of force" are, in considering the problem it is as well to assume that we have to deal with but one line of force, which extends entirely around the magnetic circuit, and compare it to something tangible, like a piece of elastic. It can be stretched by the motion of the armature more or less, but always snaps back to its original position, and is practically stationary.

It will be noticed, as one proceeds with the study of these machines, that in most all cases, one or two sliding magnetic joints (a rotary slide) seem an absolute necessity, a method of construction which has its defects, but when balanced against the hysteresis and loss from eddy currents which should be entirely absent from the successful unipolar machine, it may not result in a great drop in efficiency. It is also probable that the armature itself will form one pole of the magnetic circuit. Both these features are included in the construction of the machine shown in Figs. 1 and 2. This machine was built for experimental purposes with the idea of altering its construction as fast as new experiments demanded. It could not recognize itself now.

The point is, of course, to wind the armature. The person conducting the experiments concluded that in its original form, as here shown, it would be rather a difficult problem. Perhaps some fellow-worker would like to try it. In this machine the whole outside frame is of one polarity and the armature a consequent pole of the opposite polarity. The armature has a number of holes bored through it near the centre, from each of which extends an open slot to the rim. It also has its outer edge toothed, merely to facilitate the winding.

The machine, of which two views are shown, Figs. 3 and 4, is rather interesting because, at first sight, it looks as if it ought to work. The pole-pieces are circular, the plane of the circle being at right angles to the shaft. They are hollowed out in the centre so that two rings of opposite polarity are presented to the armature. The later is roughly shown and is a sort of Gramme ring carried by a non-magnetic spider attached to the shaft. The rim of the armature is of iron and divided into sections, which extend first to one side and then to the other. The winding is radial, the wire all in one piece, and the alternate sections wound in opposite directions.

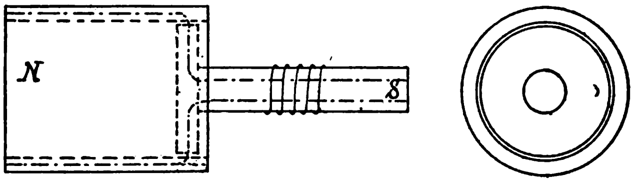


Figs. 3 and 4.

It is easily seen that if the lines of force would enter the armature at the points where it is nearest the N pole-piece and leave it where nearest the S pole-piece, the currents induced in the conductors would be in series. But they will not all go that way, at least when the armature is in motion.

Fig. 5 shows a round bar magnet with a disc at one end, inserted a short distance into a hollow iron cylinder. Suppose the magnetic circuit to be completed in any convenient manner, then the lines of alternate dots and dashes show the paths of the magnetic lines of force. If now we revolve the bar magnet about its geometrical axis, will the lines of force emanating from the edge of the disc and entering the cylinder revolve with the bar, or not? The writer believes and experimental work seems to carry out that belief, that they will not so revolve.

If this be true, it would seem to settle the question that magnetism will not "twist" when a bar magnet is revolved about its own axis. But there are other ways of moving magnetism so that it apparently twists, but in reality does not.



Figs. 5 and 6.

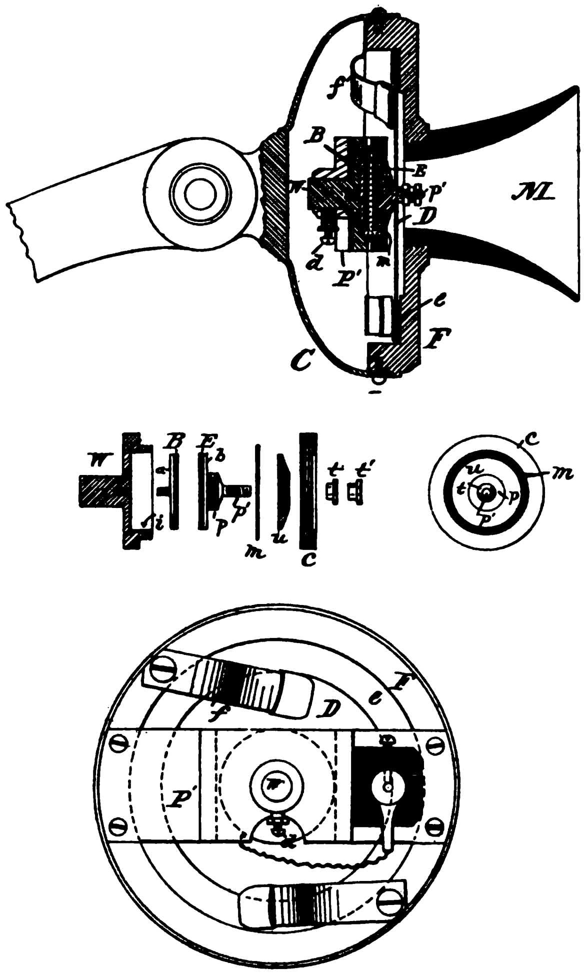
THE "SOLID BACK" LONG-DISTANCE TELEPHONE TRANSMITTER.

When the American Telegraph and Telephone Co., familiarly known as the "Long-Distance Company," began operations, the need for a more powerful transmitter than the Blake became apparent, and the Hunning type was resorted to. After considerable experimenting, the company adopted a form of transmitter having a horizontal diaphragm with the mouth-piece curving downward and forward, so that the air vibrations impinged upon the lower side of the diaphragm. It was confidently expected that with this construction, the "packing" of the granulated carbon would be avoided, and large numbers of these transmitters were put in use. It was found, however, that in time the carbon granules did become compacted, so that the transmitter required frequent tapping in order to give proper articulation. As soon as this fact became apparent, the company set about to improve this vital element in their system, and the result was what has been termed the "Solid Back" transmitter. This instrument, which has made the Chicago-New York telephone line a commercial possibility is the invention of Mr. Anthony C. White, of Boston, and its construction will be readily understood from the accompanying engravings, Fig. 1 showing the instrument in section and Figs. 2 and 3 illustrating the construction of the granular button in detail. Fig. 4 is a rear view of the transmitter.

In this instrument it will be seen, the sound receiving diaphragm D, is attached directly to the disc E constituting the front or working electrode. B is a disc constituting the heavy back electrode, and P is the finely-divided conducting material between the electrodes. A heavy metallic block, W serves as a casing or frame for the electrodes and the finely-divided conducting material, being chambered to receive them. The finely-divided material, as in other instruments of the button type, is anthracite carbon, and the two electrodes E and B are discs of carbon.

As the two transmitter electrodes must of necessity be insulated from each other, it might at first sight appear that convenience of construction of the casing W would dictate the use of an insulating material such as ebonite or wood. But as stated above, this shell is made of metal, brass being employed whose coefficient of expansion is substantially the same as that of the electrodes. The walls of the chamber in the block W are lined with gummed paper I, to prevent the short-circuiting of the instrument.

It will be observed that there is a considerable space around the periphery of the two electrodes E and B to receive the finely-divided conducting material out of the direct path of the electric current. The finely-divided material in this part of the chamber not becoming so much heated in the operation of the instrument as the portion between the electrodes, the latter portion is permitted to expand into the former and so offer less disturbance to the electrodes, due to its change in temperature. Moreover, this construction prevents the clogging of the finely-divided material between the working electrode E and the walls of the chamber W that takes place when that electrode substantially fills the chamber, thereby interfering with the proper movement of the electrode. The carbon electrode B is secured to the back on the bottom of the chambered block W by means of a brass disc *a*, soldered to the electrode and secured into the block. The front electrode E is soldered to a similar disc of brass *b*, which by a threaded boss or pin *p* and nut *u* is secured to the inner face of a mica disc *m*, that in turn is clamped to the sides or rim of the chambered block W by a threaded sleeve *c*, secured upon the block as shown, and serves to confine the finely-divided conducting material within the chamber of the block. The flexibility of the mica permits the front electrode E to have a piston-like movement in the chamber.



FIGS. 1, 2, 3 AND 4.—SOLID BACK TELEPHONE TRANSMITTER.

The entire button, it will be seen, is secured by a set-screw *d* to a heavy brass bridge-piece P′, whose ends in turn are set into the metallic frame F of the receiving diaphragm, which, with its dampening and insulating ring is held in place by means of padded springs *f*. The frame F is set in a metallic cup-shaped outer casing C.

The instrument just described is rapidly displacing the former horizontal type, and the results obtained with it would seem to indicate that "packing," that great bugbear of granulated carbon transmitters, has at last been successfully overcome.

THE CINCINNATI DISTRIBUTING TELEPHONE POLE.

BY

W J Robinson

IN keeping with the best practice of to-day, according to which all overhead telephone wires in crowded city streets are dispensed with, the Cincinnati telephone company some time ago began the work of putting their wires underground. While this in itself is a simple problem, the connection of a large number of subscribers to an underground system is by no means an easy task and must of necessity involve some overhead work in order that the cost of making connections may be brought within reasonable limits.

In order to accomplish this object the Cincinnati company has adopted a method, which embodies a number of advantages, and which the writer believes, possesses a number of novel features.

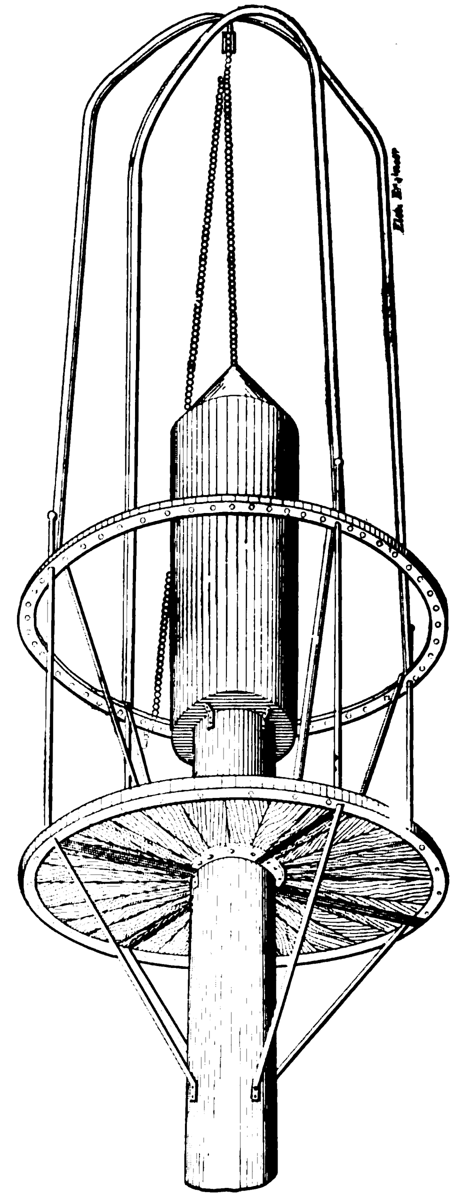
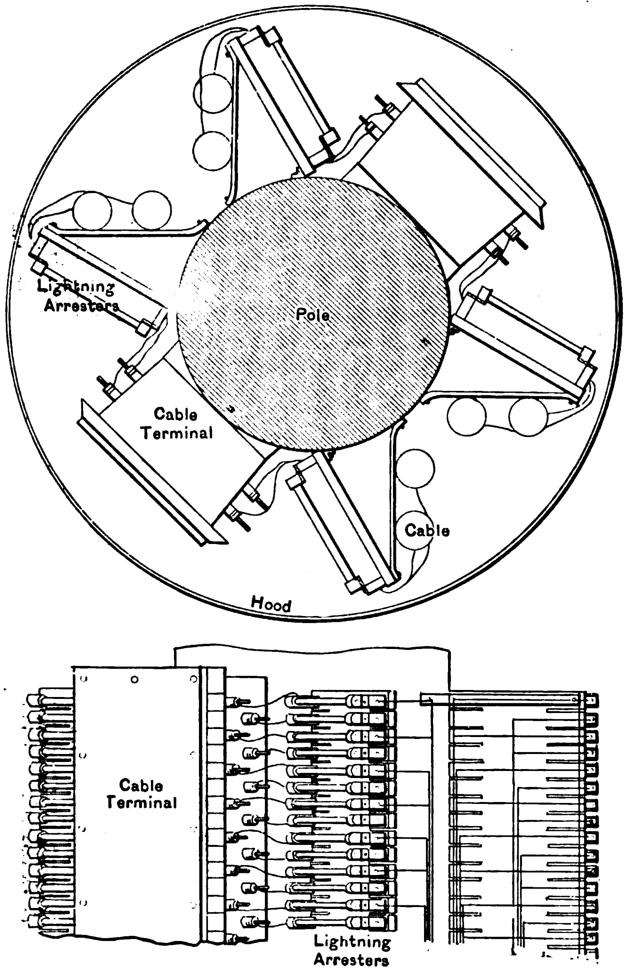


FIG. 1.—CINCINNATI DISTRIBUTING TELEPHONE POLE.

For the purpose of connecting subscribers to the underground system, distributing poles are employed which are placed in the alleys, one in the centre of each block to distribute the telephone wires to adjacent houses without crossing any of the main streets. Instead of a cable box a water-tight hood is employed. This construction was adopted for the reason that the doors of cable boxes are very apt to warp and admit rain and snow, besides which the connections are so closely compacted that difficulty is often encountered in making repairs.

In the Cincinnati pole, however, as shown in Figs. 2 and 3, connections are made inside the hood, and the lower rings and bars carry the platform for the workmen. The four iron posts that hold the distributing ring in place and the four braces, which raise and lower the hood by means of a chain and block, are also shown. The hood is adapted for fifty or one hundred pair cables, as two fifty pair cable heads can be placed under the same hood if desired, one on each side of the pole. Two strips of lead fuse arresters, one on each side of the cable head are used. The wiring from these to the cable head will be straight work, and that from the other side to the distributing ring will be in thirteen-pair Okonite cables made especially for this work. These cables will come out at the bottom of the hood and go down through the floor of the platform to the iron posts and the distributing ring, from the under side of which they radiate in all directions to the various telephones in the block. The wire used from the ring to the houses will be Okonite, $\frac{4}{32}$, with an insulation resistance of 500 megohms to the mile.



Figs. 2 and 3.—Cincinnati Distributing Telephone Pole.

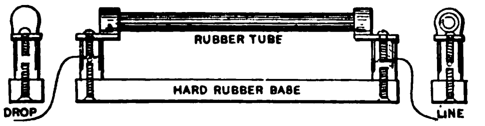


Fig. 4.—Lightning Arrester.

THE ELECTRIC ARC.[1]

BY R. S. DOBBIE.

The lecturer introduced his subject by referring to the early experiments of Sir Humphrey Davy, performed near the beginning of the century, but which had not been turned to practical commercial use until the invention of the direct current dynamo made possible the cheap generation of current. The experiment of Davy was shown, and attention drawn to the fact that the arc, which gave the name to the light, was only present when the carbons were in a horizontal position, whereas when they were in a vertical plane the bending of the arc does not take place. It was then shown that the principal source of illumination in the arc had its seat in the crater of the positive carbon, owing to the far greater heat developed at that point, as compared with that at the tip of the negative carbon. This the lecturer demonstrated by showing the condensation of the carbon vapor upon the cooler negative electrode, and the building up of the latter under certain conditions of the arc. It was also demonstrated by the fact that if a carbon positive and a copper negative electrode be employed, the carbon is deposited upon the copper electrode.

Mr. Dobbie also referred to the fact that the presence of air was not necessary to the pointing of the carbon, as the effect takes place, though in a lesser degree, when oxygen is excluded. Neither did the presence or absence of any gas affect it to a very noticeable extent.

The lecturer then demonstrated that it was possible to maintain the arc under water, the gases liberated by electrolytic action producing the effect of violent boiling. In this experiment the ends of the carbons remained practically square. In further proof that the principal seat in the arc lay in the region of the positive carbon, the lecturer described the experiments of Prof. Sylvanus P. Thompson, who explored the arc and showed that of the total difference of potential between the two carbons nearly nine-tenths was included between the tip of the positive carbon and a space barely one-hundredth of an inch from it.

Mr. Dobbie drew attention to the fact that the nature of the carbon had considerable influence on the quality of the arc, a bad carbon making it almost impossible to obtain a satisfactory light, no matter how good the regulating mechanism might be. In order to account for the brilliancy of the arc, it was well to remember that in an ordinary arc lamp from one-half to a full horse power was concentrated at a very small point.

Of the various methods to steady the arc, the author laid special stress on the cored carbon, and he showed on the screen an arc formed with such a carbon as the positive.

He next passed to the causes which might interfere with the maintenance of the arc, such as drafts of air, and showed how easily the arc could be blown out. He also demonstrated the action of an electromagnet on an arc, the effect of which also was to blow it out. The application of these principles by Prof. Elihu Thomson, of blowing out, first on the commutator of the Thomson-Houston arc machine, and then as a lightning arrester with magnetic blow-out, was touched on.

The lecturer then referred to the arc produced by alternating currents, in which both carbons were equally consumed, and in which the distribution of light was evenly divided, the same amount coming from each electrode. While to the eye an alternating arc might appear to be continuous in its nature, its alternating character could be demonstrated by rapidly passing a brilliant object in the vicinity of the arc, a reflection of which was seen by the eye. When this is done, the momentary impressions caused by alternate changes in the brilliancy of the arc are clearly shown by a series of images of the object, instead of a continuous streak of light, as would be made with a continuous, uniform quality of light.

Coming to practical arc lighting Mr. Dobbie remarked that to produce a steady light requires a properly designed generator, a good arc regulating mechanism, and finally a good carbon. He referred briefly to the fact that the arc generator must be so designed that a diminution of current increases its E. M. F.; otherwise what is known as "pumping" of the lamps would occur.

He then described more than 20 different types of arc lamp mechanism, illustrations of which were thrown on the screen from the lantern, and drew attention to the fact that some of the arc regulators made nearly 40 years ago, were quite able to maintain fairly good regulation. He laid stress on the fact that whereas formerly arc lamp mechanisms were designed with a view of maintaining the current constant, the modern arc lamps were built to maintain the potential difference constant.

At the conclusion of the lecture Mr. W. J. Hammer showed a number of photographs of high-potential arcs representing potential differences varying from 50,000 to 150,000 volts, and also a photograph of the first arc lamp made by Mr. William Wallace, nearly 30 years ago.

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[1] Abstract of a lecture delivered before the N. Y. Electrical Society, at Columbia College, Nov. 10, 1892.

ELECTRIC RAILWAY DEPARTMENT.

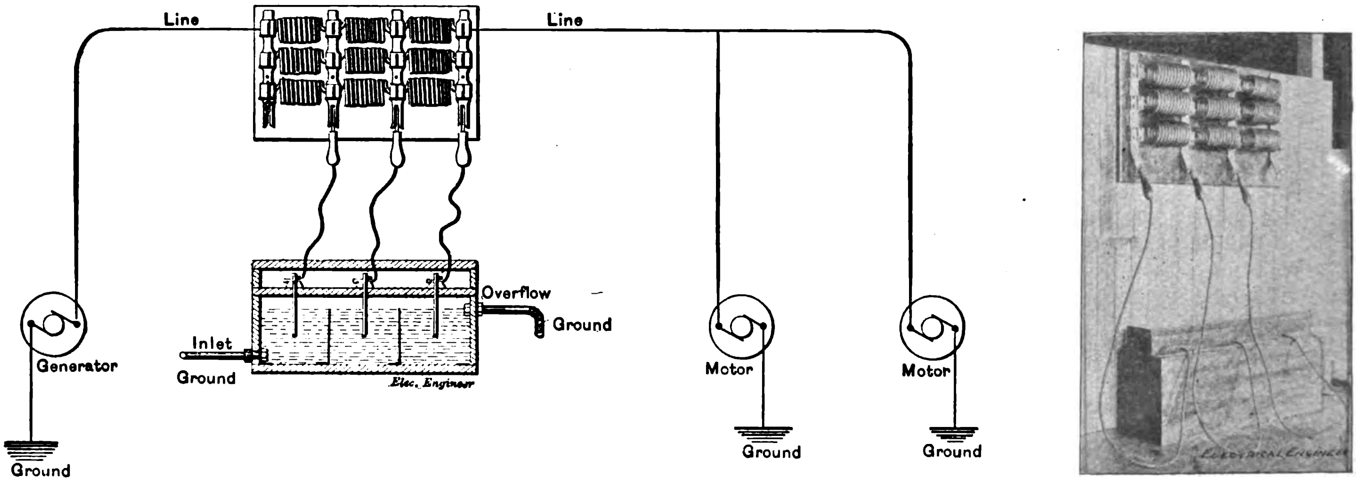
THE TANK LIGHTNING ARRESTER AS AN ADJUNCT FOR STREET RAILWAY POWER HOUSES.

BY

Alexander Jay Wurts.

THE modern electric railway plant is of such broad dimensions and represents such a large capital outlay, that any interruption in its service must seriously curtail net receipts, not only through the actual loss of fares during the hours of enforced idleness, and during which time, of course, expenses are still running apace, but also through loss of public confidence.

In many of our cities and towns, particularly in the Western sections of the country, it has been common practice during thunder storms to shut down the plant, pull down the trolleys and wait till the storm shall have spent itself. In one case, with which I am familiar, the direct losses from enforced idleness during thunder storms amount to over $6,000 per year. The value, therefore, of an efficient and reliable lightning arrester for the protection of street railway apparatus cannot be overestimated.



FIGS. 1 AND 2.—THE WURTS TANK LIGHTNING ARRESTER.

So far, the ordinary spark gap arrester has proved of value, in that it has, without question, saved many thousands of dollars worth of property. There is, however, a difficulty in connection with lightning discharges which is not usually recognized, and which, with ordinary spark spark gap arresters, is very difficult to avoid. The theory of such discharges, which observation in many cases has proved to be correct, is, that the discharge is much more likely to occur at some points in the line than at others. An arrester may, therefore, be connected to the circuit at an ineffective point (called a nodal point) and the discharge may pass the arrester and take place at another really vital point in the circuit, which, in many cases, will be the generator.

It is not an easy matter to clearly explain to the average central station man why static discharges do not readily pass through coils of wire. The simplest scientific explanation would involve technicalities which it is my desire to avoid. There is, however, one simple way of pointing to this as a fact. A trolley wire is connected to earth through the generator and motor armatures by unbroken copper conductors of large carrying capacity. Why, then, does a trolley wire need lightning arresters at all? Why do not the static charges at once pass to ground through the armature coils? Or, in other words, Why do these discharges pierce the high insulating material of the armature and jump to the frame of the generator or motor when the wire on which this charge already exists is so well grounded? It is because *static charges do not readily discharge through coils of wire,*—through the coils of an armature. The charge forces its way partly through the armature coils, and, being greatly impeded in its progress (by inductive resistance) there results what is technically known as "side flash" through the insulation to the iron frame of the generator.

The best path for the discharge is one in which it is not required to pass through a coil, and in which the resistance is low. The ideal arrester, therefore, should tend to prevent the accumulation of the charge on the line; it should afford a number of paths of low resistance from several points of the circuit and it should offer a high resistance to the passage of static charges from the line to the armature.

These requirements are admirably met by the "tank arrester," which consists of a coil of wire connected in the main circuit with several discharge circuits leading from different points in the coil to electrodes immersed in a tank of water, the latter being connected to the ground. This arrester is particularly adapted to the protection of street railway generators. Its construction will be readily understood by referring to the diagram, Fig. 1, the apparatus itself being shown in Fig. 2.

The coils, made of No. 0000 copper wire, are nine in number, arranged three in series and three in parallel. The current capacity of No. 0000 wire is about 300 amperes, so that the capacity of the entire set of coils may be varied by any multiple of this number. The set shown in the engraving has a capacity of 900 amperes, and is mounted on a backboard, the dimensions of which are 32 x 20 inches. The tank is of wood, lined with galvanized iron, and its dimensions are 32 x 28 x 10 inches. The three electrodes are ordinary flat arc light carbons held in simple clamps, and the method of connecting these to the coils is clearly shown. The inlet is, of course, connected to the city main and thus forms the best possible ground connection for the tank. The coils are connected in series with the station ammeter, and when thus connected, will stand guard over the entire station. The action of the combination is as follows:

All charges which may accumulate on the trolley line or feeders will be forced to pass through the coil before reaching any of the generators. The function of the coil is then to cause the fatal "side flash" to occur *there* rather than in the coils of the armature, and this is the more readily accomplished from the fact that there are several low-resistance paths from this coil to earth without the necessity of piercing any insulating material or jumping over the smallest air space. In other words, there is an exceedingly difficult path for the lightning discharges to reach the generators, and an extremely easy path for them to reach the earth. Furthermore, the fact that the line is directly connected to earth without the intervention of the air gap, offers a constant drain through which the static charge may dissipate itself, that is, the charge need not accumulate on the line till its intensity is sufficient to jump the spark gap of an ordinary lightning arrester.

Dynamo leakage is, of course, to be expected, and during the first stages in the development of this arrester the leakage was so excessive that the scheme would have been abandoned had it not been for the fortunate discovery that this leakage was reduced about 70 per cent. by the use of running water. With running water fed through a ½-inch pipe at ordinary city pressure the leakage amounts to 6 or 7 amperes at 500 volts. But in consideration of the almost certain protection that the arrester will afford, this loss of power sinks into insignificance, and in fact the leakage need only occur during thunder storms, as the discharge circuits may be cut out at other times by pulling the plugs shown in the engraving.

The advantages of this arrester may be summarized as follows:

1. The presence of the coil in the dynamo circuit, which prevents the discharge from passing to the dynamo and forces it through the tank. 2. The opportunity for constant leakage of the charge, by which the accumulation of a charge sufficient to break through the insulation of the generator is avoided. 3. The numerous discharge circuits connected with the coil which secure facility for discharge from a number of points, thus avoiding with certainty the nodal points of the circuit. 4. The avoiding of a short circuit on the generator at the time of a discharge, and the possible injury to the generator or the opening of the circuit breaker. 5. The affording of paths to the ground, avoiding the use of coils or inductive circuits in the discharge path and securing low ohmic resistance. 6. The fact that one arrester will protect all the generators in the power-house.

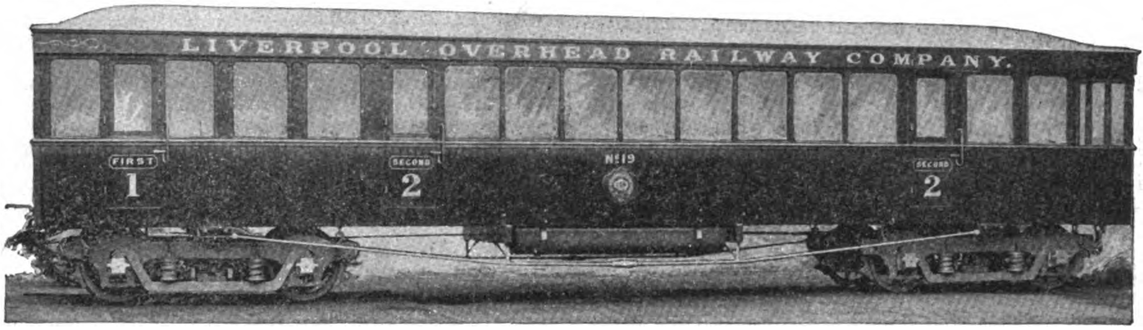
A number of these arresters have been in use during the past season in various sections of the country, and those who have reported their experiences write in unqualified terms regarding the wonderful protection afforded by this arrester.

THE BALTIMORE-WASHINGTON ELECTRIC ROAD.

The traction syndicate plan for a road between Baltimore and Washington will be enlarged and the road extended to Philadelphia. The company has been incorporated under the laws of Maryland as the Washington and Baltimore Boulevard and Electric Railway Company. The incorporators' act requires that the work on the road shall begin within six months and be completed within 24 months after the passage of the act. It is proposed to run trains at the rate of 60 miles per hour. The fare from Baltimore to Washington will be 25 cents. This is the largest electric railway project on foot in the country to-day.

THE CARS FOR THE LIVERPOOL ELEVATED ELECTRIC RAILROAD.

We have already published some details about the elevated electric road which Liverpool is soon to have, but may repeat some of the details. It will run parallel with the docks a distance of about six miles, with sixteen stations very much after the New York model. It is to be worked by electricity, generated at a power house about the middle of the line. At this station are four engines, each capable of working up to 400 in licated horse power, and each driving an Elwell-Parker dynamo of the familiar vertical, consequent pole type. The current will be carried by a steel conductor, placed on porcelain insulators, supported upon cross-timbers between the rails of each track. Hinged collectors of cast iron, sliding upon this conductor, will make the connection. The motors are not placed upon a separate locomotive, but are carried by the passenger carriages, one of which is shown in the accompanying illustration, for which we are indebted to the *Railroad Gazette*.



Car for the Liverpool Elevated Electric Railroad.

Two carriages, each seating fifty-six passengers and provided with a motor at one end, will constitute a train. The carriages are to be so coupled as to give a motor at each end of the train, and the motors will be so connected together as to be controlled from either end by the driver, who will always change ends upon arrival at a terminus. The driver will carry a key, without which the motor cannot be operated. All the carriages will be alike, but they will contain compartments for two classes of passengers. A train loaded with passengers will weigh about forty tons. The carriages will be lighted by electricity and fitted with the Westinghouse brake. The speed is to reach a maximum of from 20 to 30 miles an hour. The total cost of this railway, including equipment, will not exceed $425,000 a mile.

ELECTRIC RAILWAYS AT TORONTO, ONT.

The amended proposal of the new electric street railway company has been accepted, and the old street railway company given thirty days in which to accept the bargain. By the arrangement with the new company the work of building the track must be begun between November 15, 1892, and March 15, 1893. Seven miles of the railway must be completed, and the electric cars running thereon within two years. At the end of twenty years the city may, after six months' notice, assume the ownership of the railway on payment of its value, to be determined by arbitration. The company will pay yearly to the city $100 per mile of single track and $205 per annum per mile of double track, if the gross receipts of the railway are $60,000 a year. The company will also pay on all gross receipts under $100,000, 5 per cent.; between $100,000 and $125,000, 5½ per cent.; between $125,000 and $150,000, 6 per cent.; between $150,000 and $175,000, 6½ per cent.; between $175,000 and $200,000, 7 per cent.; over $200,000, 8 per cent.

BONDING ELECTRIC RAILWAY TRACK.

BY

A. K. McCay.

I HAVE read the excellent paper of Mr. R. L. Warner on the "Resistance of Return Circuits in Electric Street Railways," in last week's issue of the ENGINEER, with great pleasure, and heartily agree with him in every respect. I am glad we have had some actual experiments in this line and we can now count on the resistance of the return circuit as more or less a known quantity.

I would call attention to one particular point in tables B and C, namely, that there is an appreciable difference in the resistance when the ground is wet, as we all know. I had occasion to improve the return circuit of a certain railroad not long ago and placed heavy copper plates 18 x 14 inches in two streams which were over a mile apart but which flowed directly into the same river; these plates were bonded to both rails with No. 4 copper wire; the result was very appreciable and the saving in coal was quite considerable. The track referred to was bonded with No. 6 galvanized iron bonds 28 inches long and cross-connected at every other rail. There are a great many roads crossing streams where this method could be used, and I am sure, to advantage. The thanks of electrical engineers are certainly due to Mr. Warner for this exhaustive article.

AN INSTITUTE DISCUSSION ON ELECTRIC RAILWAYS.[1]

THE discussion was opened by DR. CARY T. HUTCHINSON, who took up the subject of "Series Traction," and first referred to the pamphlet issued in 1888, by the company exploiting Prof. Sidney H. Short's system of series traction, in which it was sought to prove that this method possessed enormous advantages over the multiple arc method of operating railway cars. Dr. Hutchinson showed the errors in this pamphlet, one of the most glaring being the assumption of the loss in conductors, and the cost of that lost power. Instead of Mr. Short's assumption that it cost $12.00 a day for coal to run the electric car, in multiple, it was demonstrated that the actual cost was but $1.00 a day.

Referring specifically to Mr. Perry's paper, Dr. Hutchinson agreed with the author that the thing worked beautifully on paper, but the employment of movable switches with magnets to open and close them, with trolley wheels for them to run on and connect three wires at the same time in many cases, etc., appeared to put this system beyond the pale of practicability. Another point to be considered was the fact that to run a large number of cars would require enormous potential differences. As a single dynamo cannot be constructed to give over 5,000 volts, it would be necessary to divide the line into sections, which would have to be very short for city work and would involve more switches. Mr. Perry seemed also to have neglected the fact that a constant current motor was a very different thing from a constant potential motor. While the latter could be run at double its nominal capacity for a short time, a constant current motor at once comes to a dead standstill if the load is greater than that for which the machine is designed; in other words, it had no margin of overload. Such a motor for street car work would therefore have to be built for the greatest load which it could possibly get, and again the regulation of such motor would require either the variation of the field, or the shifting of the brushes, the latter of which would cause sparking. Besides, the series system is necessarily a double trolley system, which of itself would condemn it. While it was true that the series system has somewhat the advantage in saving of copper, the cost of copper, although a large item in its self, was by no means the total cost, and the reduction of copper cost to one-half or one-fifth its present value would not be sufficient to counterbalance the other disadvantages entailed in the series system.

Regarding the "Electric Railway Motor Tests" made by Prof. Shephardson and Mr. Burch, Dr. Hutchinson remarked that they were evidently made with crude apparatus, and some of the conditions of the tests were not accurately specified. He drew attention to the waste occurring by the use of the 5th and 6th clip in the regulating rheostat with a Sprague No. 6 motor, and compared some of his tests, published in THE ELECTRICAL ENGINEER, of Oct. 12, 1892, with those of Prof. Shepardson. In these tests electrical methods were used entirely, in contradistinction to mechanical measurements. The curves showed that a No. 6 motor had an efficiency of 83 per cent. at 20 amperes, falling to 80 per cent. at 35 amperes, and running down in the other direction to 80 per cent. at about 12 amperes. That was to say, between 10 and 35 amperes the efficiency at the armature shaft is above 80 per cent. The efficiency with the gears with 35 to 15 amperes is fairly constant at about 75 per cent. These tests showed very much better efficiency and better results in every way than any which he had seen published except some which were distributed at the recent meeting of the Street Railway Convention, at Cleveland, relating to the new Short gearless motor. The claim was made that this motor reaches a maximum of 87 per cent. at 7½ h. p., and is practically constant up to 14 h. p. The efficiency from 5 to 21 h. p., averages about 83 per cent.

Dr. Hutchinson drew attention to the important remark in Prof. Shepardson's paper that an average of 12 tests on a road showed that with two motors on a car it required 27 per cent. less current than when only one was working. The explanation was to be found in the fact that with two motors, each motor was working at lighter loads, and consequently at lower efficiency.

As to the comparative value of the rheostat and commutator methods of field regulation, Dr. Hutchinson thought the matter could be definitely decided by submitting the result of actual tests. He submitted a table showing the comparative efficiency, which showed that in every case the commutated field method gave an efficiency higher even than the electrical efficiency with rheostat, and much higher than the best probable value of the actual efficiency.

Coming to Mr. Leonard's paper on the new system of electric propulsion, Dr. Hutchinson admitted that it possessed the property of allowing the car to start very easily, and the current would not rise above the value of current required for moving the car, and also running at any speed, and on any grade, without the great waste caused by using up the difference between 500 volts and that which is applied to the terminals of the driving motor. Dr. Hutchinson, however, did not agree with Mr. Leonard's calculations as to the relative power required to operate cars by that system, and by the usual method. He figured that with Mr. Leonard's system an efficiency of 33 per cent. would be reached, as against 54 per cent. calculated by Mr. Leonard. With the same driving motor governed by rheostat, an efficiency of 19 per cent. would be reached, while with the commutated field method it would be 27 per cent. The difference between 33 and 27 per cent., that is, 6 per cent. was too trifling to compensate for the complication involved in Mr. Leonard's system.

Regarding Mr. Leonard's claim that his system would permit of a reduction in power equipment, Dr. Hutchinson referred to the fact that it was based on the assumption that railway managers would be satisfied with a speed of three miles per hour on heavy grades, which was not to be entertained in this day of rapid transit. He also gave a table of tests as given by Mr. Leonard, and one calculated by himself, which showed the cost of equipment per car to be $7,430, as against $4,200, the present cost, and as against $3,430 calculated by Mr. Leonard. Reference was also made to the much greater weight of the Leonard equipment.

DR. CHAS. E. EMERY remarked that in all brake equipment, the apparatus ought to be very closely criticised, and he showed how errors might very easily creep into such measurements. On the subject of the variable speed gear, which Mr. Leonard had sought to work out electrically, he had sought to solve the problem by mechanical means, by the employment of a pump with variable capacity to drive a hydraulic motor fixed on the axle. Other workers in the same field had proved that it was necessary to stop frequently to allow the liquid to cool off. A car equipment on this principle had been constructed near New York. Dr. Emery thought that Mr. Leonard had a strong competitor in the shunt motors recently built by Siemens Bros. & Co., and operating the new locomotives on the City and South London Electric Railway. Their use was only made possible by building the motors heavy enough, with plenty of iron in the field.

MR. C. O. MAILLOUX referred to the great facility for regulation afforded by the use of the storage battery in electric railway work, which was, in fact, one of its strongest points. One of the readiest means it afforded, was to divide the battery into groups, to run in parallel at the start, and then gradually group them into different arrangements for series, multiple, and so on. By this means a variable electromotive force was obtained as in Mr. Leonard's system, but without his machinery. It also allowed of the ready operation of the motors at starting, and their coupling in parallel later. Mr. Mailloux believed that the method of using batteries in parallel with motors at the same time was first tried by himself on Fourth avenue, in 1887.

Regarding variable speed devices, Mr. Mailloux did not think that the extra complication overcame the other objectionable features. He had tried an epicyclic gear train for this purpose, but had abandoned its use as it introduced additional levers, which the motormen oftentimes operated in the wrong way.

MR. FRANK J. SPRAGUE referred to his experience at Richmond five years ago, where twenty cars were run with multiple series switches used with the commutated fields, they worked perfectly as far as the slowing down of the machine, etc., was concerned; where it failed was when, on heavy grades, the attempt was made to run the machines in series, or when stopping on a slippery track. One motor would then begin to race and the other would slow down, if there was slipping on the track on account of ice or sleet, or from any other cause. He was much amused by the claims made for the series multiple regulation; as to its effectiveness there was no question, but the series multiple system when running at full service would make little difference in the coal burnt. The result was that he abandoned the series multiple switches, and ran the machines invariably in multiple.

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[1] Abstract of a joint discussion on Oct. 25, 1892, of the papers read at the General Meeting of the American Institute of Electrical Engineers, Chicago, June 8, 1892, on "Series Electric Traction," by Nelson W. Perry; a "A New System of Electric Propulsion," by H. Ward Leonard; and "Electric Railway Motor Tests," by Prof. Geo. D. Shepardson and Edw. P. Burch.

Mr. Sprague stated that in the latter part of 1886, he had supplied Mr. Wharton, of Philadelphia, with motors to be operated by storage batteries, which were grouped in various combinations with the motors also arranged for multiple series grouping of both armatures and fields. It was found not to be very satisfactory because so complicated.

PROF. F. B. CROCKER, referring to Dr. Emery's remarks on the employment of shunt motors on the City and South London Railway, stated that the conditions there permitted of their use, as trains there normally run at full speed with a clear track, the only time at which they ran slow being at the starting. This mode of operation was diametrically opposite to that of ordinary surface street car practice, and hence precluded the employment of such motors on surface roads. He had early recognized the objectionable features of dead resistance for regulating motors, and in 1884 was one of the patentees of several devices for commutating fields.

DR. EMERY, in reply, stated that the Siemens motors referred to showed an efficiency of 90 to 92 per cent. for a variation of speed between 12¼and 30.6 miles per hour, as tested by brake in the shop.

MR. CHAS HEWITT stated that shunt motors for street cars had been not entirely neglected in this country, and it was certain that the original was not made by Siemens & Halske. He thought that Mr. Sprague had tried it in the early days. One of the objections to the employment of the shunt motor on railroads was the constant breaking of the circuit caused by the jumping of the trolley, due to unevenness of the trolley wire. With a shunt motor, every time the trolley leaves the wire the shunt field is discharged, and when the trolley strikes the wire again, a short circuit through the armature occurs. He was under the impression that in London they used the third rail in addition to a top-running trolley wheel so that the contact is ensured at all times. As the whole tendency of street railway practice was towards greater simplicity, he doubted the practical success of Mr. Leonard's system. He did not think that the difference between the two motors was due so much to low efficiency as to the difficulty of making two motors run together, so as to divide the loads equally between them. The matter had been simplified recently by giving each motor a distinct circuit.

MR. MAILLOUX stated that he had always operated motors with an independent circuit for each.

MR. FRANK J. SPRAGUE was of the opinion that series electric traction was now a thing of the past, and might be allowed to rest in peace. While improvements were being made in the perfection of apparatus in electric railways, he was of the opinion that little, if any, increase in actual economy had been attained over that of the early roads. Four years ago 40 cars were running on the Richmond road with engines of 375 h. p.; in other words, 9 h. p. per car at the central station. Indeed, he thought that in some things we had retrograded, such as in the additional complication of apparatus, which gave the motormen too much to think of.

Mr. Sprague thought that when considering the time limit involved in starting with Mr. Leonard's system, the amount of coal burnt in the central station would be fully as great as, if not greater than, that with the system of direct supply, owing to the energy needed for the continuous rotation of the power converter. Regarding the employment of Mr. Leonard's system for elevator work, the same time element entered, but in a far greater degree, as in the case of an elevator the period of rest to that of actual duty was in a far greater ratio, and in Mr. Leonard's system one machine would have to be kept in constant operation, taking current no matter whether the elevator was in operation or not. In 1886 he had operated two shunt motors on an elevated railroad in New York. The speed of the car was controlled first by the rheostat, and second by the variation in field strength, the energy of the car being thrown back to the line in slowing. Later he introduced the series method of regulating machines. Considering the fact that with the shunt motors, a certain amount of energy can be returned to the line, he questioned very seriously if the shunt motor would not hold its own in time on a great many lines of street car service.

DR. HUTCHINSON, speaking of the power per car required to operate a line, referred to a case in Baltimore, where a grade of 6 per cent. was mounted at a speed of eight miles an hour. Here 60 h. p. equipments were employed. A single car on that road averages 205 miles daily, probably the highest on record, the rest making 190 miles. Tests made on that line showed that the horse power per car, measured from the engine, the cars being equipped with old Sprague double reduction motors, amounted to $6\frac{3}{10}$ indicated h. p. minimum, and 8 h. p. maximum. These measurements, which were made two years ago, would, if made to-day, probably show anywhere from 12 to 19 indicated h. p. per car.

MR. MAILLOUX believed that the time was soon coming when the value of storage batteries in taking care of the large fluctuation in loads at railway power stations, would be recognized, and that no engines had yet been devised which thoroughly accomplished the object.

MR. SPRAGUE referred to the increased economy to be obtained by direct connected dynamos. He was of the opinion that for large railroad work it was essential that there should be at least two, and possibly four, motors in operation. The series system would be used for running at variable speeds, and the machines would be compound wound. He was now concerned with others in building an electric locomotive of about 700 h. p. which would have four motors of 175 h. p. each. In the work on the locomotive now being designed by the General Electric Co., for the B. & O. R. R., under the original Thomson-Houston plan, they would probably use four or six with various combinations.

MR. H. WARD LEONARD stated that accurate tests of his system had been made by W. Sellers & Co., of Philadelphia, and that the efficiencies shown in his table had been quite well borne out. He did not think that 6 h. p. at the central station would be enough with every car in operation simultaneously, but that it represented the average per car, some being at rest, others going slowly, going down grade, etc. As to the cost of his system he did not consider it an important factor, because in a railway installation which he was equipping, the actual cost of the car equipment was only five per cent. of the cost of the complete work. Practice has shown that the attention required by the apparatus in his system was practically nil, and the machine being entirely sparkless, required no attention for months at a time. This system also had only one lever for the motor men to operate, which would give all speeds, reverse, and apply the braking action to the car. Under normal use no mechanical brakes would be required. With this system, when the speed was sufficient to require the entire 500 volts on the line, the switch would apply it directly, and thus avoid the transformation and loss hinted at by Dr. Hutchinson, the motor being shunt wound. As to his system in elevator work, sufficient trials had been made to enable him to say that its efficiency was well known. A traveling crane to be erected at the World's Fair, perhaps the largest ever constructed, will be so operated, and the use of the system on passenger elevators will be thoroughly tested in the new *Herald* Building, the United Charities Building, in New York, as well as in other buildings.

Replying to a question from Mr. Sprague, Mr. Leonard said that the location of his transformer would be determined by the style of the truck; at present it was laid out to be placed between the axles of the car, so that the axis of the motor generator would be parallel to the track.

THE FARMER IN ELECTRIC RAILROADING.

A RECENT issue of THE ELECTRICAL ENGINEER contained an article on the opportunity that the electric railway offered the farmer of handling his produce cheaply and of placing himself more directly and closely in communication with the country at large. It was urged that the highway without a track on it had ceased to be a highway in the full sense of the word. Mr. William Nelson Black, in the November issue of the *Engineering Magazine*, now presents the same idea with the supplement of some further arguments, many of them very strong. He goes moreover into a calculation of the cost and says: "An accurate estimate cannot of course be made here, because conditions differ so widely in different sections of the country; but as close a calculation as we can make in advance, founded on the cost of the electric railroads already in operation, warrants us in saying that probably 90 per cent. of the railways in the United States could be equipped with the necessary track, poles, and wires at a cost of $3,500 per mile. In a district 10 miles square—the surface that could be served from a single central power station—there would be, in the larger part of the Union, about 100 miles of railway. Then the total cost of track for a district 10 miles square would be $350,000. This represents a capitalization of only $5 to the acre, and an annual interest charge of only 30 cents per acre. With a central power station large enough to operate all the wagons or cars that would be called into use at one time in a district, the capitalization need not be more than $10 per acre. This would mean an annual interest charge of $60 for each hundred acres of land. It must be conceded that this does not seem like a very heavy tax when we consider the nature of the service rendered available, the great saving in the cost and maintenance of horses and wagons, the enormous economy of time, and the greatly enhanced value of improved farm lands. If the interest charge amounted to $100 per year, and the farmers were themselves chiefly the stockholders of the electric companies, it would still represent an economy."

MR. J. A. MCLURE, superintendent of construction of the Short Electric Railway Co., has resigned that position and joined the forces of the Siemens-Halske Co. of America, with headquarters at Chicago.

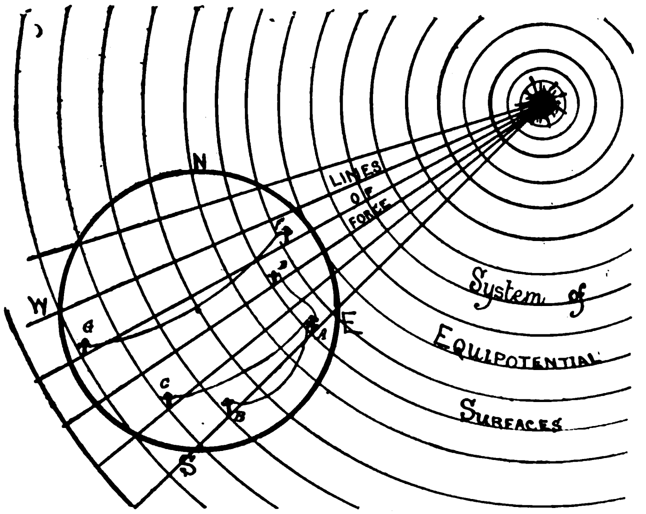
MISCELLANEOUS.

EARTH CURRENTS.[1]

BY WM. FINN.

THE author began by discussing magnetic or electric storms, their causes and effects, and the probable way in which these electrical disturbances, produced by solar convulsions, are transmitted in waves through the ether and imparted to what he termed the "electrical atmosphere" of the earth, inducing electrical waves, or earth currents. During the prevalence of these earth currents, he said, the earth's surface is divided into equipotential planes, between any adjacent two of which a difference of potential always exists. The greatest interruptions are invariably felt along lines of force running across these planes.

The accompanying diagram roughly illustrates the manner in which an electrical disturbance is propagated from the sun to the earth. The disturbing force gives rise to a series of electrical impulses which are transmitted in all directions through space in the form of spherical waves which develop upon the surface of the earth those lines of equal pressure or potential represented in the drawing as circles or portions thereof. The electric force like many other forces diminishes with the distance according to the law of inverse squares, but the value of the force at a given point on any one of the circles is the same as at all other points on the same circle because they are all equally distant from the centre of disturbance. Hence such a circle represents an equipotential surface along which the natural forces are inactive. All other surfaces, however, will necessarily have different values, and therefore an inequality of potential exists which tends to create an E. M. F. in any telegraph wire connecting the various circles. It is this difference of potential which drives the electricity through the wire.



The straight lines radiating from the sun represent the lines of electric force along which the earth currents are impelled with the greatest velocity, as it were. Telegraph circuits that run along these lines of force, such as A B and F G, are the ones *most* strongly affected. Circuits that cut the equipotential circles at other than a right angle, as A C, are not so seriously troubled, while those wires terminating on any part of an equipotential surface, as A D are absolutely free from interruption.

If we know the direction in which the circuits are entirely destitute of earth currents, we can deduce therefrom the line of maximum force, for that line is always at right angles to the system of equipotential surfaces.

These planes generally run about north and south in this country, and it is on that account that telegraph lines extending in this direction are found comparatively free from interference during abnormal earth current visitations, while those wires running across the equipotential planes, experience the maximum disturbing effects, which accounts for our easterly and westerly circuits being the greatest sufferers at such times.

The magnitude of the forces developed in the wires evidently bears some relation to the length of the circuit, as might be naturally supposed, and experience shows that the maximum potential difference exists as a rule between the terminal grounds of our longest wires. During the past term of storms for instance, the circuits between New York and Buffalo, which vary from 450 to 482 miles in length, exhibited the highest E. M. F's.; the value of which on several occasions exceeded 600 volts, and on Aug. 12 last, reached the unprecedented magnitude of 768 volts.

Twice or thrice during the recent storm period, there appeared to be a sudden shifting of the equipotential planes to an easterly and westerly direction, which is quite an unusual, as well as remarkable, circumstance, and one quite difficult to properly account for. At the times referred to, the wires north and south, which had previously experienced little or no interruption, became totally unworkable, whereas the easterly and westerly route appeared to be more or less clear of the earth currents. There were times also when a number of wires between the same points would be influenced in such a manner, that while one or two might be found perfectly workable the rest could not be operated at all. These curious anomalies together with other strange inconsistencies that were noted at the time, can only be explained on the supposition that some of the equipotential lines instead of forming portions of spherical surfaces, were more or less distorted by the action of other disturbing influences into highly irregular figures such as the spectrum of one magnet would show in the presence of other magnets. Irregular curves formed in this way and passing through the various points noted—*all being necessarily at the same potential*—would render possible the maintenance of regular communication between such points.

The author then devoted some time to the various theories concerning normal earth currents, and showed diagrams of readings taken upon a portion of the Atlantic cable in 1857 illustrating electrical tidal effects. The effect of local interferences upon the working of telegraph lines was then considered at length, and the paper closed with the statement that, although the phenomena of earth currents are but imperfectly understood, their effects are so universal and important that it requires no great stretch of imagination to conceive the possibility of an extended application of these currents to useful purposes at some future time.

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[1] Abstract of a paper by read before the Brooklyn Institute of Arts and Science.

SOCIETY AND CLUB NOTES.

NEW YORK ELECTRICAL SOCIETY.

THE last meeting of this Society was held on November 10, at Columbia College. Mr. R. S. Dobbie delivered an interesting lecture on "The Electric Arc," with experimental demonstrations, an abstract of which will be found in another column. The interest shown in the Society's work is evinced by the rapid increase in its membership, over thirty new members having joined during the last month. The course of experimental lectures, which has been arranged, will be carried on throughout the winter. Full information and tickets of admission can be obtained from Mr. Geo. H. Guy, Secy., Room 812, 203 Broadway, New York.

"A HOUSE WARMING."

THE ELECTRICAL ENGINEER entertained its many friends on Wednesday afternoon, Oct. 26, in its handsome new offices in the *Mail and Express* Building, 203 Broadway, New York. An elaborate luncheon was served to the several hundred gentlemen present, who thoroughly enjoyed the hospitality of the popular staff of our esteemed contemporary, whose marked success in the field of electrical journalism is so pronounced and so deservedly earned.—*Street Railway Journal.*

CONSOLIDATION OF EICKEMEYER-FIELD INTERESTS.

A CERTIFICATE of consolidation of the Eickemeyer-Field Company, the Eickemeyer Dynamo Machine Company and the Yonkers Machine Company, under the name of the Eickemeyer-Field Manufacturing Company, has been filed with the New York Secretary of State. The company has a capital of $1,000,000, and will construct power and electric light plants and manufacture electric railroad equipments at Yonkers. The directors are Rudolf Eickemeyer, Henry Osterheld, Stephen D. Field, Norton P. Otis, and William D. Baldwin of Yonkers, and E. A. Nichols and Samuel Shethar of New York City.

A STEEL OBSERVATORY FOR NIAGARA.

BUFFALO capitalists propose to erect a steel observatory 250 feet in height at Niagara Falls. The plans and specifications call for a structure 70 feet at the base, 250 feet high, tapering to 18 feet at the top. The frame will be built of four main columns 15 inches square, around which the covering will be placed. A platform 88 feet in circumference will surround the top, furnishing room for 80 people to stand. Two elevators propelled by electric power will travel the vertical path leading to the top. They will have a capacity of 25 passengers each, and make the journey in half a minute. The entire structure will be brilliantly illuminated by electricity.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED NOVEMBER 1, 1892.

Alarms and Signals :—

District Alarm Box, C. W. McClellen, Chicago, 485,351. Filed Aug. 1, 1891.

Has for its object to prevent false alarms by sounding an alarm at the sending box simultaneously with the one at the main station.

Electric Signal, G. McIntosh, Stonington, Conn., 485,352. Filed March 10, 1892.

Has for its object to provide an auxiliary circuit of low amperage through the commutator operated by the motor which shall make and break the circuit for directly operating the signal.

Electric Bell, J. R. Hard, New York, N. Y., 485,379. Filed June 7, 1892. (See THE ELECTRICAL ENGINEER, Nov. 9).

Electric Danger Signal for Moving Trains, J. McCarty and A. G. Judkins, Trenton, Mich , 485,473. Filed Sept. 26, 1891.

Watchman's Electric Time Recorder, J. A. Tilden, Hyde Park, Mass., 485,591. Filed June 22, 1892.

Distribution :—

Electric Lighting System, W. H. MacKay, Roanoke, Va., 485,287. Filed June 13, 1892.

Employs lights placed in a branch of the main railway circuit and means whereby this branch circuit may be closed from a single point.

Electric Intermutator, H. G. O'Neill, Louisville, Ky., 485,425. Filed Feb. 9, 1892.

Provides automatic means for rapidly and intermittently distributing current to a number of points.

Dynamos and Motors:—

Dynamo, W. H. Elkins, Cambridge, Mass., 485,181. Filed Oct. 7, 1891.

Employs two sets of brushes at points of normally different potential, taking equal current at full load, and two sets of field-magnet coils, the one connected to one set of brushes, and to the work circuit, and the other between the brushes.

Dynamo Electric Machines, D. Pepper, Jr., Philadelphia, Pa , 485,220. Filed March 28, 1892.

Provides means for constructing field-magnet coils and armature rings in sections.

Regulation for Dynamo Electric Machines, E. Thomson, Lynn, Mass, 485,239. Filed April 6, 1888.

Employs means for taking current from a section only of the armature winding irrespective of the main current connections, a device responding to this current and controling mochanism for shifting the brushes of the machine.

Armature Core for Electric Motors and Generators, A. J. Lehman, New York, 485,284. Filed Jan. 30, 1891.

An armature core composed of magnetic gauze rolled upon itself and soaked in a solution of shellac or similar substance.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, W. A. Crowdus, Memphis, Tenn., 485,319. Filed Dec. 18, 1891.

Claim 1 follows :

In a galvanic battery, a battery case provided with metal rods extending through it from top to bottom and connected at their bottom ends to the respective electros of the battery.

Heating:—

Electrical Heater, H. G. O'Neill, Louisville, Ky., 485,424. Filed Feb. 2, 1892.

Employs a steatite heater body and a non-conducting cement for attaching the wires to the heater body.

Lamps and Appurtenances :

Electric Arc Lamp, J. A. Mosher, Chicago, Ill., 485,293. Filed Jan. 2, 1892.

Employs a carbon rod provided with a fiber plug having a groove and a contact adapted to move in electrical contact with the rod and engage the groove.

Electric Arc Lamp, E. R. Knowles, Stonington, Conn., 485,327. Filed Nov. 24, 1891.

Employs a vertically-moving perforated ribbon, supported to the frame of the lamp, as a means for raising, supporting and feeding the upper carbon.

Electric Arc Lamp, H. Japy, Beaucourt, and O. Helmer, Paris, France, 485,347. Filed Mar. 22, 1892.

Relates to the construction of differential arc lamps designed to operate in circuit with either a continuous or an alternating current generator.

Incandescent Electric Lamp, E. Pollard, Cambridge, Mass., 485,478. Filed Mar. 2, 1892.

Employs two bands or deposits of silver upon the filament-supporting tube extending through the seal and forming an electrical connection between the filament and conducting wires.

Electric Arc Lamps, E. A. Edwards, Cincinnati, Ohio, 485,537. Filed Nov. 25, 1891.

Employs a positive refractory stop against which the positive electrode rests, the negative electrode being fed toward the positive in a direction substantially at right angles to the length of the latter.

Socket for Incandescent Electric Lamps, J. S. Potter, Newton, and D. J. Cartwright, Boston, Mass., 485,587. Filed Oct. 6, 1890.

Consists of a block of porcelain provided with recesses at opposite ends separated by a partition, and contacts connected with the conducting wires and mechanically attached to the partition in the socket.

Miscellaneous:—

Automatic Governing Device for Electric Pumps, F. A. Pocock, Lynn, Mass., 485,221. Filed Mar. 20, 1891.

Employs a float by means of which the level of the water in the tank controls the current.

Device for Treating Patients by Electricity, E. M. Thomas, Little Rock, Ark., 485,238. Filed Jan. 11, 1892.

Apparatus for Winding Wire, F. B. Chase, Chicago, Ill., 485,256, Filed Jan. 4, 1892.

Self-Induction Device, W. Stanley, Jr., Pittsfield, Mass., 485,336. Filed April 19, 1891.

Employs a laminated magnetic core, a continnous magnetic coil, whose sections are wound through perforations in said core, a series of contact plates to which the sections are attached, a contact lever for including more or less of the sections, and a circuit for alternating currents.

Method of and Apparatus for Electro Deposition of Metals, C. R. Fletcher, Boston, Mass., 485,348. Filed Oct. 5, 1891.

Electrical Door Trip for Engine Houses, A. Bosch, Newark, N. J., 485,367. Filed March 14. 1892.

Alloy, H. G. O'Neill, Louisville, Ky., 485,423. Filed Jan. 30, 1892.

An anti-fusion alloy of great electrical resistance consisting of stated proportions of tin, silicon, nickel, and zinc.

Jail or Vault Construction, D. K. Osbourne, St. Paul, Minn., 485,506. Filed Sept 8, 1891.

Employs metallic pipes with wires therein adapted to sound an alarm when the pipes are in any way disturbed.

Construction of Jails, D. K. Osbourne, St. Paul, Minn., 485,559. Filed Jan. 4, 1892.

Similar in its object to 485,506.

Coin Controlled Stereoscope, J. Ringen, St. Louis, Mo., 485,567. Filed Feb. 12, 1892.

Railways and Appliances :—

Underground Electric Trolley System, R. B. Ayres, New York, N. Y., 485,252. Filed March 23, 1892.

Has for its object to provide means for electrically operating all kinds of signals arranged in a continuous line as well as all kinds of tripping mechanisms to operate such signals at certain distances apart.

Underground Electric Conduit and Trolley Bar for Electric Railways, J. S. Moss, Martinsburg, W. Va., 485,555. Filed April 16, 1892.

Has for its object to provide a conduit wherein the trolley bar is constantly insulated from the edges of the slot and the latter is effectually closed to exclude water, etc.

Switches and Cut-Outs :—

Circuit Switch, M. E. Sullivan and J. Doss, Denver, Col., 485,387. Filed April 2, 1892.

Has for its object the division of the main circuit into independent sections.

Electric Switch, J. C. O'Neill, Cleveland, Ohio, 485,558. Filed Oct. 14, 1891.

Telegraph :—

An arc circuit switch for house service.

Combined Telegraphy and Telephony, W. W. Jacques, Newton, Mass., 485,279. Filed April 8, 1892.

Claim 1 follows.

The combination of an electrostatic inductive resistance and an electromagnetic inductive resistance in an electric circuit.

Electromagnetic Telegraph Apparatus, A. G. Safford, Washington, D. C., 485,334. Filed Mar. 16, 1892.

Has for its object reduction of the resistance of the main circuit and increased sensitiveness in the receiving instrument, as well as the ready adjustment to varying pressure of the circuit.

Telephones and Apparatus :—

Telephone, A. C. White, Boston, Mass., 485,311. Filed Mar. 24, 1892.

Provides means for overcoming the tendency to pack of the finely divided conducting material and undue heating of the essential parts. (See this issue THE ELECTRICAL ENGINEER.)

LEGAL NOTES.

EDISON ELECTRIC LIGHT COMPANY AND EDISON GENERAL ELECTRIC CO. vs. SAWYER-MAN ELECTRIC CO.

THE hearing in the suit of the Edison companies for preliminary injunction against the Sawyer-Man Co., postponed from November 4 to November 11, has again been laid over until Friday, November 18.

LETTERS TO THE EDITOR.

ANSWER TO THE QUESTION ON "SPARK LENGTH."

IN answer to the question on "spark length" submitted in your issue of November 2, I would submit the following:

The potential is approximately 2,000 volts. Between 1,500 volts and 25,000 volts the sparking distance between parallel metal surfaces in air can be approximately expressed by the formula:

$$d = 22\,V + \tfrac{1}{2}\,V^2 - 14,$$

d being the distance in mils or thousandths of an inch, and V, the potential, in thousands of volts.

CHAS. P. STEINMETZ.

YONKERS, N. Y.

THE SPRAGUE-PRATT ELEVATOR.

I HAVE just read the interesting description of the Sprague-Pratt electric elevator in your issue of November 2. It is, no doubt, the intention of the writers, that all who read this article shall get the impression that this elevator overcomes all difficulties heretofore known in the art, or which possibly can arise. Certainly there is mechanism enough about the machine to provide for almost any contingency, and yet in the attempt to overcome all that "friction" on the 'travelling nut," the projectors have overlooked what would happen in case the "vicious boy" attempted to start the elevator with an overloaded car. It looks to me very much as if the controlling motor would gradually, but surely, cut all the resistance out of the armature circuit, and then, the armature remaining stationary, either the fuses or the armature would be destroyed. In either event, the annoyance of waiting for repairs is encountered. I wonder if this condition was one of those imposed on the elevator in West Twenty-third street. If so, it would be interesting to know the result.

WM. A. ROSENBAUM.

NEW YORK, Nov. 4, 1892.

PERSONAL.

MR. G. G. WARD, the vice-president of the Commercial Cable Company, after an absence of about six months, returned from Europe not long since. Mr. and Mrs. Ward were compelled by circumstances to spend the twenty-fifth anniversary of their marriage on the S. S. "City of Paris" in mid-Atlantic, but they were not forgotten by their friends and admirers in the Commercial Cable Company, who, a few days after their return home, surprised them overwhelmingly by the presentation of a silver dessert service. It is an exceedingly handsome set, made and engraved by Tiffany.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

Advertising is a constant want and should be a constant study.

TEST OF THE STROWGER AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

A LARGE party of gentlemen comprising a number of Chicago's prominent citizens, electrical experts and newspaper representatives visited La Porte, Ind., on Thursday, Nov. 3, to inspect the new automatic telephone exchange, the invention of Mr. A. B. Strowger, which has just been installed there, being the first system demonstrating the practical application of an automatic exchange, and which was formally opened on the occasion, having been completed but a few days. A special train for La Porte on the Lake Shore and Michigan Southern was provided which left the city at 10.30 in the morning and reached La Porte about noon. Lunch and refreshments were served on the train and the commissariat in the hands of Mr. Jos. Harris, Mr. M. A. Meyer and Major C. J. Wickersham was handled in a masterly manner and is something to be remembered by the guests for a long time to come. The party reached La Porte about 1 o'clock where the town's cornet band had turned out to receive them, and preceded the visitors to the offices of the Strowger Company. Mr. H. H. Craig, New York agent for the company, received the guests and introduced Mayor Scott, of La Porte, who extended the freedom of the city and made a short and cordial address of welcome. Mr. A. B. Strowger, the inventor of the system, was introduced and made a short speech touching on the pleasure the present demonstration gave him as the fulfilment of his hopes and related a few of his experiences while working out the system and reviewed the history of the telephone and the tribulations of the telephone girl whom his automatic apparatus is designed to relieve and retire. Mr. H. M. Underwood, who has charge of the construction and Mr. A. E. Keith, the electrician of the company, were on hand to explain the practical working and details of the system and for the next couple of hours the guests amused themselves by calling up every one in town who had telephones and asking questions about how they liked the new system, and so forth; replies being invariably favorable. The following were among those present: H. G. Flederman, S. S. Vandervort, Major Charles J. Wickersham, Prof. John P. Barrett, William Hood, General William Sooy Smith, A. D. Tingley, James W. Scott, F. S. Perry, Chief Swenie S. Engel, W. F. Collins, C. Gentile, Albert Fishell, C. A. Barre, J. A. Loebe, H. W. Perce, John M. Smyth, C. F. Dunderdale, M. B. Heller, M. M. Cohn, Phillip Howarth, M. A. Meyer, S. H. Mallory, G. R. Stewart, William Corroll, Fred. Le Land, B. B. Farwell, Dr. S. Cole, W. H. Rattenburg, Eli D. Felsenthal, E. E. Yaxle, Oscar Stein, J. Harris, A. B. Strowger and J. F. Mehren.

J. W. PARKER & CO.

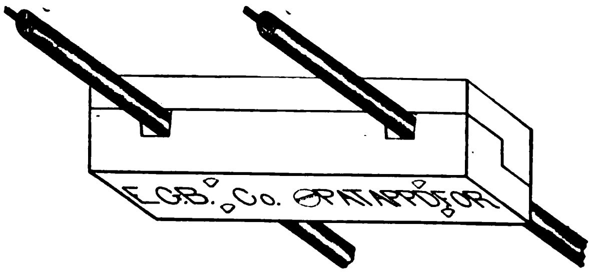
THE above firm, of 38 South Fourth street, Philadelphia, report the following sales during September and to date: North Hudson Elevated Railroad, Hoboken, N. J., two 250 h. p. Standard improved Ball engines, of Erie; Suburban Electric Light Company, Scranton, Pa., one 200 h. p. Standard improved Ball engine; Elkton Electric Light Company, Elkton, Md., one 80 h. p. improved Ball engine and 90 h. p. boiler, and entire plant construction; Milton, Pa., Electric Light Company, one 100 h. p. improved Ball engine; Bloomsberg, Pa., Electric Light Company, one 100 h. p. improved Ball engine; Pottstown Light, Heat and Power Company, Pottstown, Pa., one 250 h. p. cross-compound Ball engine; Penna. General Electric Company, Philadelphia, Pa., for shipment to Malten, West Va., one 80 h. p. engine and 90 h. p. boiler and complete plant, erection, the whole latest improved manufactures of the Ball Engine Company, of Erie, Pa.; the Wm. A. Rogers Company, Philadelphia, Pa., one 50 h. p. Standard improved Ball engine. This company reports inquiries to be very numerous, and the best business they have ever had. Besides the reports given above, they have several good contracts for their high grade special boiler; they are building two of these, each 150 h. p., for the Bethlehem, Pa., Electric Light Company; a large stack for same company and construction work for their new improvement.

THE BERNARD ADJUSTABLE CHINA CLEAT.

THE accompanying illustration shows a new form of china cleat especially designed to meet the requirements of insurance experts, who have recently prohibited the use of wood for this purpose. It has had the advantage of a practical test and is found to be strong and easy to put up.

As will be seen, the top and bottom are exactly alike and are interchangeable. The cross-section is designed for strength, and, as it is held in place by means of only one screw and the four fixed lugs, perfect alignment is secured. It is made of superior imported clay, thoroughly vitrified, and is furnished both glazed and unglazed.

This device is manufactured by the E. G. Bernard Company, of 7 First street, Troy, N. Y., and is supplied to the trade by the Western Electric Co., the E. S. Greely & Co., and Alexander, Barney & Chapin, of this city. The makers report that although orders have not yet been solicited to any extent, over 100,000 cleats have already been sold.



BERNARD ADJUSTABLE CHINA CLEAT.

PURITY OIL FILTERS.

THE PURITY OIL FILTER MANUFACTURING CO. have announced that Messrs. W. R. Fleming & Co., 203 Broadway, will henceforth represent them in this city, and, by way of showing what is going on at their works, report the following sales, some of which are second orders: Ferries and Cliff House Street Railway Co., San Francisco, Cal., one No. 2 Ideal oil refiner; Mineral Point, Wis., Zinc Co. one No. 1 Eureka; Tennessee Manufacturing Co., Nashville, Tenn., one No. 4 Ideal oil refiner, second order; Plattsburg, N. Y., Light, Heat and Power Co. one No. 2 Ideal; Vacuum Oil Co., Rochester, N. Y., Royal Electric Light, Heat and Power Co. one No. 2, Purity Filter, Front Royal, Va.; Judson Manufacturing Co., Oakland, Cal., one No. 2 Ideal; Detroit, Mich., Citizens Street Railway Co. one No.1 Ideal; Rockaway, N. J., Manufacturing Co. one No. 1 Ideal refiner; Carnegie Steel Co. Ltd. for Homestead Steel Works, second order, one No. 2 Ideal refiner; New Castle, Pa., Wire Nail Co., second order, one No. 4 Ideal refiner; Indiana, Pa., Electric Co. one No. 2 Ideal; Frederick, Md., Electric Light and Power Co. one No. 1 Ideal; People's Light and Power Co., Silver Creek, N. Y., one No. 1 Purity filter; Pittsburg Plate Glass Co., fourth order, one No. 3 Purity filter. This company is also in receipt of the following gratifying letter:

MACON, GA., Nov. 2, 1892.

PURITY OIL FILTER MANUFACTURING Co. Pittsburgh, Pa.

Gentlemen:—Enclosed pleased find cheque for $50, to pay for No. 2 Ideal refiner purchased from you some time ago. We find your oil refiner all you represented and more too than you claimed for it. We were determined to be satisfied as to its merit before paying for it as we have been humbugged several times before. When we put the refiner to work we were using 150 gallons of oil per month. Now with the aid of the refiner we use only 50, which saves the price of the refiner in one month.

Yours respectfully,
Metropolitan Street Railway Co.
S. A. MITCHELL, general manager.

MR. J. STANFORD BROWN, consulting electrical engineer, of Camden, N. J., may be addressed to advantage by those having arc lamps suited to run on 500-volt railway circuits, and by persons manufacturing electric heaters.

THE HARD ANNUNCIATOR DROP.

Last week we illustrated and described the new bell and dry battery of Mr. J. Randolph Hard, of 2 and 4 Howard street, this city.

Another very neat device just brought out by Mr. Hard is an annunciator drop shown in perspective in the engraving, Fig. 1. The construction of this drop will be readily understood by referring to the diagram, Fig. 2, which shows a top view of the drop and Fig. 3 which shows it in position in the annunciator. As will be seen, the armature is carried by a spring, which has a collar soldered to the spindle upon which it turns. When the drop is set for action, the armature is held in position opposite to the core of the magnet by a knife-edge which engages a slot in the top of the armature. When the button is pushed current is sent through the magnet coil, the armature is attracted, clears the knife-edge and by its own weight drops into the indicating position, shown in the upper magnet, No. 1, Fig. 3.

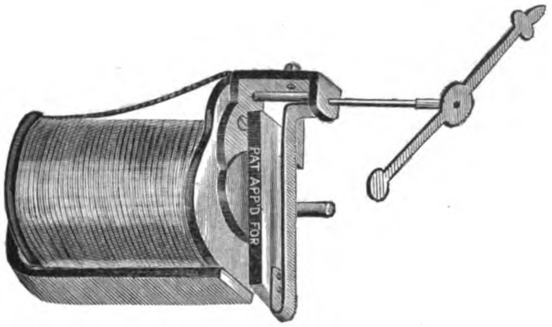


Fig. 1.—Hard Annunciator Drop.

The construction here adopted, it will be noted, is exceedingly simple. It cannot get out of adjustment, as the whole drop device is attached to the magnet, and is independent of the warping of the woodwork. The arrangement is such, also, that the most violent jarring will not release the drop, and thus give false signals. The tests which we have witnessed are sufficiently convincing of the character of the drop in this respect. As the armature is directly suspended, it requires but a minimum amount of battery to release it from the knife-edge, the friction amounting to almost nil, owing to the entire absence of pivots.

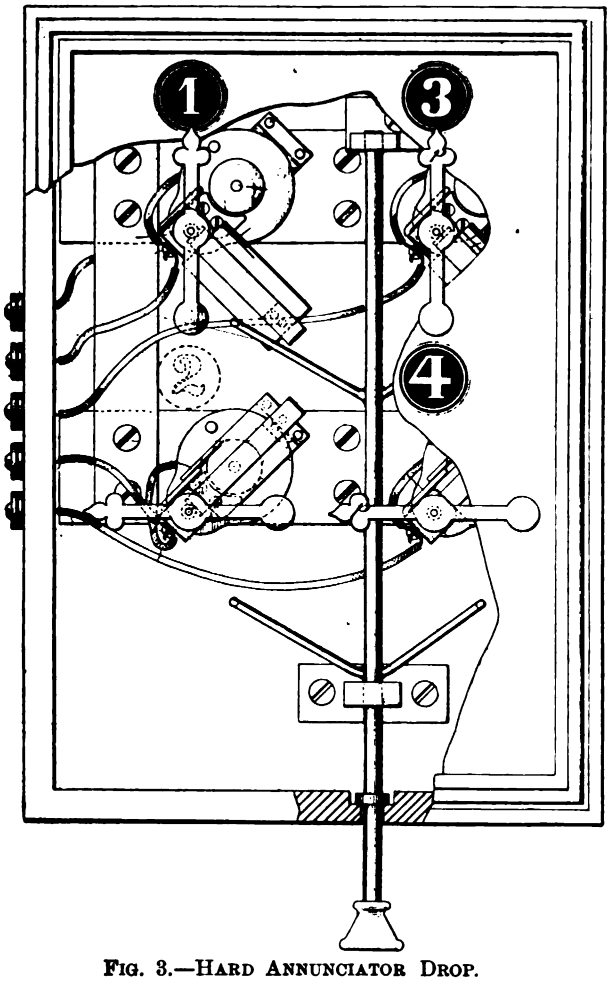


Fig. 3.—Hard Annunciator Drop.

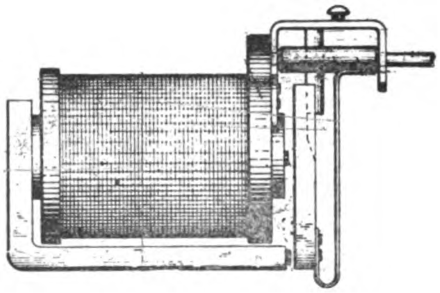
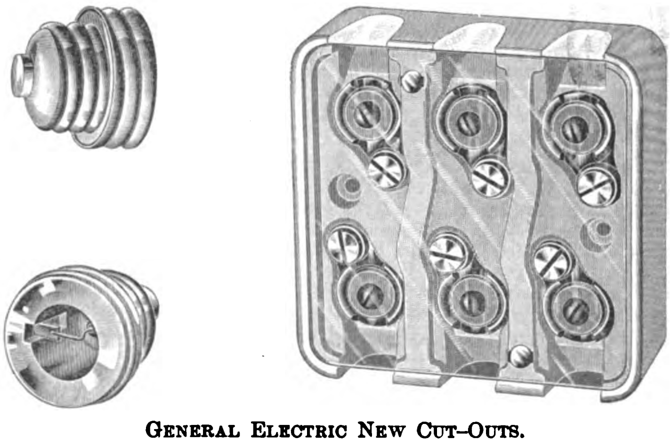


Fig. 2.—Hard Annunciator Drop.

Our engraving Fig. 3, shows an annunciator, with four such drops arranged in working order; the drop No. 2 being in position before the pushing of the button, and drop No. 1 after.

GENERAL ELECTRIC CO.'S NEW STYLE CUT-OUTS.

Improvement in the manufacture of the smaller electrical appliances keeps pace with that of the larger and more important devices, each moving toward perfection. We here show some improved pieces of wiring apparatus, which the General Electric Co. has just brought out. The old style porcelain plug and link cut-outs have disappeared and the new ones here shown take their places as substitutes of greater efficiency. They are made of hard, white, thoroughly vitrified porcelain, impervious to moisture, and impassable to the electric current. the metal parts possessing all the qualities necessary to render them electrically efficient. The plug cut-outs are designed to protect a circuit having a maximum current of 30 amperes at 125 volts. The fuse is carried in a small glass plug, cased and covered with brass, which is screwed into a brass screw socket in the body of the cut-out. Should the fuse blow, the defective plug can be instantaneously replaced, without tools of any kind. In the link cut-outs, the fuse is a safety link with copper terminals. The binding screws and wire terminals are set well below the surface of the cut-out, and are protected by suitable sheet-mica covers. The porcelain of which these cut-outs are manufactured, is itself made by the General Electric Co. at its own porcelain factory at Schenectady, established in order that the quality of this important material should be of the highest possible standard of excellence.



General Electric New Cut-Outs.

Mr. Harry S. Smith, who for several years past has been connected with Walker & Kepler, Philadelphia, has severed his connection with that firm, and associated himself with some well-known electrical men who will be known hereafter as the Harry S. Smith Co., Ltd., and located at 607 Chestnut street. They will handle the Eddy apparatus in isolated plants. They are also agents for the Eddy dynamos, Safety Insulated Wire and Cable Co. and Packard incandescent lamps, and will keep a stock of general supplies for all systems of electric lighting.

WESTERN NOTES.

The Premier Steel Company, Indianapolis, Ind., have issued an announcement of their elevator department of which Mr. Clinton B. Osgood is general sales agent, with offices at No. 319-320 Manhattan Building, Chicago. The Premier Steel Company have lately added to their immense works at Indianapolis, an elevator department, and are now fully prepared to manufacture electric, hydraulic and steam elevators for passenger and freight service. Before entering the business, electrical and mechanical engineers, fully alive to the requirements of their large and increasing business, were engaged, and have placed elevators in fine buildings near their place of manufacture so as to be constantly under their supervision, that any faults developing might be remedied before soliciting business. The Premier Steel Company have paid particular attention to the developing of an electric elevator that shall be perfectly smooth running, safe, high-speed, using a minimum amount of current and be free from the annoyances of repairs. One of these machines has now been running for the past eight months and has never been shut down for an hour. It is said to be giving the best satisfaction to the users, and has been highly praised by those who have seen it in operation and has not had $1.00 of repairs since it started in service. Now that every point of its efficiency and economy has been proven to the Premier Steel Company they are prepared to contract and erect their machines wherever required. Mr. Clinton B. Osgood, their general sales agent, was for some years connected with one of the largest and most prominent elevator companies in the United States and for the past five years has been prominently connected with the Sprague Electric Railway and Motor Company and the Westinghouse Electric and Manufacturing Company. He will be pleased to give detailed information regarding not only electric, but hydraulic and steam elevators.

James P. Warren, No. 51–53 North Jefferson street, Chicago, is doing a large business with electric light and railway plants with his "Acme" exhaust head. This head is especially designed for electric plants and high speed engines, so as to economize exhaust steam. Mr. Warren guarantees it to stop all water and grease that is emitted from the exhaust pipe and by condensing it, the hot water runs down a conductor and up a passage into the bottom of the head and from thence through a detachable drip pipe into a tank or cistern from which it can be taken for boiler feed, washing or other purposes. By the use of this device, roofs, walls, windows and surrounding buildings are protected from the water and grease that escapes from an exhaust pipe. Among other advantages of the head are that it frees itself from grease and sediments while in use. and is a great benefit to all non-condensing engines. They are made of heavy galvanized iron and guaranteed to last for several years. Mr. Warren has just sold the Brush Electric Light Co., of Cincinnati, a 14-inch exhaust head, which is stated to be working in first-rate shape. This head goes on a 500 h. p. engine.

The Universal Electric Co., 739 Cedar avenue, Cleveland, Ohio, has been recently organized with Mr. N. S. Possons, president and manager, universally known among electrical people all over the country from his long association with the Brush Electric Co. Mr. Geo. R. Lean is vice president and superintendent, and Mr. W. J. Possons, formerly of the Brush Electric Co., secretary and treasurer. The new company are taking up a highly novel class of business, namely, that of repairing lamps, rendering them, it is stated, fully equal to new lamps. They replace broken and burned out filaments, remove the soot and smoke which adheres to the inside of the bulb, finishing up the lamps so that they are exactly as new. This process makes a material saving to the users, as the cost of repairing is much less than new lamps. The company also report that they are making segments and tempering same, casting them from copper for commutators, as well as for all electrical work where great strength and good conductivity are required.

The Columbia Mfg. and Supply Co., 340-342 Dearborn St., Chicago, of which Mr. D. F. Coykendall is president, Mr. Thomas Hull, vice-president; Mr. John T. Todd, secretary and treasurer, and Mr. C. R. Baum, superintendent, are doing a light manufacturing business in electrical instruments, tools, gears, etc. They also represent the Standard Thermometer Co., of Peabody, Mass. Mr. Todd expects to place on the market, shortly, several valuable electrical devices of his own invention.

The Bain Electric Mfg. Co., manufacturers of electric light, power and electric mining machinery, 47 and 49 S. Jefferson street, Chicago, are constructing two large mining locomotives, and also have under way an electric under-cutting coal mining machine. Their new arc lamp for series arc and direct incandescent circuits are proving very satisfactory.

The Chicago Incandescent Light Co. report business as very good and are turning out a large stock of their incandescent lamps. Mr. Thos. Pray, Jr., is general manager and electrician, and has charge of the factory and personally supervises the output. Mr. Stephen Lissenden is treasurer, and attends to the business of the concern.

Mr. Carl K. MacFadden, electrical engineer at present in charge of all electric plants on the Chicago & N. W. Railway Company's system, has resigned his position and will join forces with Taylor, Goodhue & Ames, 827 Monadnock Building, Chicago. Mr. MacFadden is a young man of much more than usual ability and sound to the core on questions pertaining to electrical engineering.

Mr. Frank R. Ford is now settled down in Chicago as manager for the Short Electric Railway Co. here, with a fine suite of offices in the Monadnock Building. Mr. Ford is a very energetic gentleman, well versed in street railway work, and will, undoubtedly, prove very successful both for himself and his company in this section.

The Standard Battery Co., 324 Dearborn street, Chicago, are filling a number of orders for their iron gravity batteries for railroad telegraph work. Mr. A. P. Willoughby, the inventor of the iron electrode for gravity batteries, has also about perfected a new battery for light power, such as sewing machine work.

Mr. B. E. Davis, representing Pass & Seymour, the well-known manufacturers of electrical specialties and the celebrated Syracuse china, of Syracuse, New York, was among the recent Chicago visitors. Mr. Davis, while here, found time to drop in at the Western office of **The Electrical Engineer**.

Taylor, Goodhue & Ames are receiving a large number of orders for the Burton Electric Car Heaters. They have recently furnished twenty-four sets to three large Western roads. This speaks volumes for the heaters as all these are repeat orders from roads who have used the heater during last fall.

The Acme Oil Filter.—Taylor, Goodhue & Ames have been appointed general selling agents for this filter and have certain exclusive territory. The filter is a good one and possesses the advantage of a steam chamber which can be used to good advantage in cold weather or with extra thick oil.

Mr. Wells Goodhue of the firm of Taylor, Goodhue & Ames is, it is reported, hard at work upon an electrical poem expected to appear during the festal days of Christmas. Rumor has it that it incidentally touches on the fate of the yellow dog who fell asleep on a Burton heater.

Mr. T. A. Pamperin, general manager of the Electric Mfg. Co., Oconto, Wis., whose office here is at No. 239 La Salle street (Wm. Hood & Co., managers), spent several days in Chicago, last week. Mr. Pamperin received the usual hearty welcome from his many friends.

The Great Western Electric Co. 207 South Canal street, Chicago, are enjoying an excellent run of business in all lines of supplies that they handle. Sun arc lamps are in good demand as also are Howard incandescents and many of their other specialties.

Mr. C. B. Fairchild, the editor of the *Street Railway Journal*, New York, spent several days in Chicago during the past week. Mr. Fairchild is making quite a Western trip, and will, no doubt, find many things to interest him in street railway matters.

Mr. H. Jenkins, who is well known among electrical people here, has accepted a position with Fraser & Chalmers, the large manufacturers of mining machinery, steam engines and boilers, of Chicago, in their city sales department.

Mr. Wm. J. Chalmers, vice-president and treasurer of Fraser & Chalmers, returned some little while ago from Europe, after a two or three months' trip there. The company has extensive works in England.

CANADIAN NOTES.

The Canadian Electric Light Co.—The Dominion Government has under consideration for approval the plans of this company for developing the water power of the river at the side of the Island of Montreal opposite to that on which the city is situated. It is proposed to dam the river at Sault-au-Recollet, which would obliterate the rapids at this place and it is estimated yield from 15,000 to 20,000 h. p. for conversion into electricity and transmission to Montreal, seven or eight miles distant.

The Canadian General Electric Co.—The following officers have been appointed: President, W. R. Brock; first vice-president, H. P. Dwight; second vice-president and general manager, Frederic Nicholls; assistant general manager, M. D. Barr; comptroller, Walter S. Andrews; chief engineer, W. M. Rutherford; assistant engineer, H. T. Hartman; purchasing agent, Geo. W. Watts; superintendent Peterboro factory, Wm. S. Andrews; superintendent Hamilton factory, C. S. Stilwell.

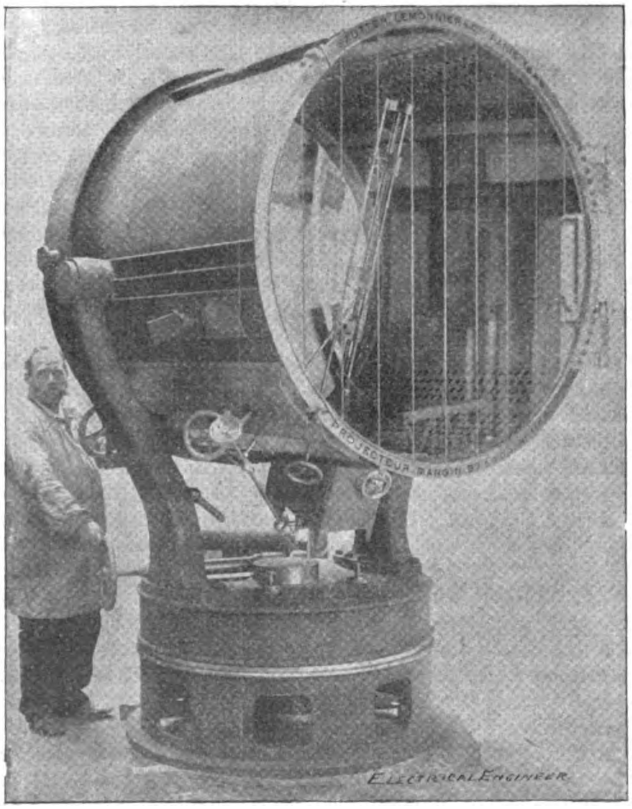
☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XIV. NOVEMBER 23, 1892. No. 238.

THE LARGEST ELECTRICAL PROJECTOR IN THE WORLD.

THE interesting experiments made towards the end of the present summer with an electrical projector at the summit of Mt. Washington, which were fully described in our issue of September 28, by Mr. A. C. Shaw, have attracted attention not only in this country, but abroad. Among others we have received a communication from Messrs. Sautter, Harlé & Co., of Paris, the well-known French electrical constructors. In order to prevent the impression from getting around that the Mt. Washington projector is the most powerful one in the world, they draw attention to the fact that there exist in France, England and Russia, as well as in other countries, projectors of larger diameter, serving as coast defences. Whereas the Mt. Washington projector has a reflector of 30 inches, those in use abroad have reflectors 36 and 40 inches in diameter, and even this is by no means the limit.



The Largest Electrical Projector in the World.

The most powerful projector in the world was that constructed for, and exhibited at the Paris Exposition in 1889 by, Messrs. Sautter, Harlé & Co. This apparatus of which we give a reproduction from a photograph kindly furnished us by the above firm, has a reflecting Mangin lens of the same type as that of the Mt. Washington projector, but of no less a diameter than 60 inches. It was immediately after its construction acquired by the French Navy Department.

The Mangin reflector throws the rays absolutely parallel, which is demonstrated by experience with an arc lamp, taking a current of 200 amperes. This lamp can be operated either automatically or by being manipulated from the outside by means of hand wheels and rods.

The carbons employed have a diameter of $1\frac{9}{16}$ inch for the positive, and $1\frac{3}{16}$ inch for the negative. This 60 inch Mangin projector provided with a tilted lamp taking 200 amperes of current has, it is claimed, a luminosity of 267 million candles. The luminosity of the sun at the zenith being 53,500 candles, it follows that an object placed at a distance of 230 feet in the path of the projected rays, would be lighted as clearly as if exposed to the rays of the sun at noon in summer.

INCREASED COMMERCIAL EFFICIENCY AND HIGHER ECONOMY IN CENTRAL STATIONS—II.

BY

J. H. Vail

HIGH ECONOMY ENGINES.

THERE can be no doubt but that the central stations constructed in the United States for the next few years to come will require engines of highest economy as well as of larger powers than those heretofore employed. We must anticipate stations of larger capacity, in which, I believe, the units will range from 500 h. p. upward, rather than of smaller capacities.

In this connection, it must not be forgotten that the successful status of central station business of the present day has been achieved by the almost exclusive use of the simple high speed engine belted to dynamos running at high velocity. Instances are on record where in the same town, under same conditions, it has been proved that net profit could not be obtained with a slow speed engine and intermediate shafting, and where a high speed engine added to the same plant has been the turning point toward financial success. Therefore, whatever changes we may make in the future, we must not forget to give due credit to that type of engine which has been one of the corner stones of success in electric light stations. This is not intended in any manner to reflect on or question the economy and value of the slow speed engine in electric power stations, as the writer has in numerous instances endorsed the use of the same, and will continue to do so when the nature of load and specific conditions of operation will insure higher economy as the result.

In no instance should the system of duplicate generating units be abandoned. We must not fail to keep in mind the fact that where large generating units are applied, the disabling of one means the stopping of a large percentage of the station capacity. It is most desirable to build up the station capacity with several generating units, so that in the event of a breakdown only a small fractional part of the total capacity will be unserviceable. Absolute reliability is an essential element of success in electric lighting.

Engines for duty in electric power stations require to be exceptionally well proportioned and extremely heavy in all parts. They must be capable of withstanding, without damage, the instantaneous adding or cutting off of the entire load. They must also be constructed with a view of prolonged continuous running at full load. In fact, the service required is more stringent than that on ocean steamers or with railroad locomotives.

The importance of exact duplication of parts and interchangeability of those parts most subject to wear or breakage, must not be lost sight of. In large units, the changing of an armature on a shaft, or the dismantling of an engine to lift a large shaft, may be a work of many hours at best; if new parts are not found to fit, this may be extended to a work of days. A steamship engineer who has taken a liking to electric power station service recently remarked that "he had sailed on many a ship that could lay by and hoist canvas for repairs and would soon get to port, but the central station ship must always keep under way and never reach port."

The greater coal economy to be obtained by using compound or triple expansion engines is constantly presented in ways more or less attractive, and in many instances to sell an engine or cater to a popular idea, without due regard as to whether such a type will really be economical in a specific central station, when all the points of local conditions, required duty, first cost and future operating expenses are duly considered. It must be perfectly evident that we do not want to apply a compound engine where the conditions are such that owing to variable or intermittent load, the engine falls off in economy so that the steam it requires will be equal to, or average more, in pounds of water per horse power hour than the simple engine of less cost; but it is evident that the compound engine may be used to advantage where its application will reduce the average fuel and water consumption sufficiently below that of the simple engine. A recent report says that the results of a long series of tests made on several railroads, to prove the average economy of the compound over the simple locomotive, sum up into a final saving of 16.9 per cent. of coal and 14.1 per cent. of water. We may therefore safely anticipate considerable saving in fuel with compound non-condensing engines, while we may expect better results under constant heavy loads and with condensation.

One of the main questions after all, is the amount of saving in fuel which can be effected by the use of improved apparatus, and another, whether the saving in fuel will be materially greater than the interest on the increased cost plus the additional repairs on the more complicated engine. We must estimate an annual charge of interest on the increased cost of apparatus, this to be deducted from the net value of coal and water saved. It is therefore evident that the investment may only be warranted where coal is dear and may not be economical where fuel is cheap.

To obtain economical results in the daily operation of central stations having an aggregate of from 1,000 to 4,000 h. p. capacity, I believe that, as a rule, the triple expansion engine should not be operated with less than three-quarters its normal load. If the minimum load of the station should be such as to reach below this proportion of load on engine, I would suggest that the load be then taken up either by the ordinary high speed engine and belted dynamos, or by a smaller size of compound condensing engine either driving belted dynamos, or having direct driven multipolar dynamos. It will be understood that in large stations the minimum load will probably be sufficient to be carried on a triple expansion generator of 300 to 500 h. p. capacity.

The improved station of medium capacity should therefore be equipped with two or more simple high pressure or with compound condensing engines for service during hours of small load, and with two or more triple expansion condensing engines and direct driven dynamos for heavy load service. We may also anticipate in very large stations the future application in exceptional instances, of quadruple expansion engines.

Another important point in this combination of engines as recommended must be perceived, namely, that to run a simple engine during the hours of light load, engineers of less skill will be required than during the hours of heavy load, when the larger and more complicated types of engines are in service; on this latter watch more experienced men will be necessary. Should a station be arranged with triple expansion engines for high steam pressure, the simple engine must be specially constructed so as to operate at the high pressure, or, if an ordinary engine, a reducing valve should be interposed or lower boiler pressure carried.

In deciding upon the type and size of engine, great care must be observed as to conditions to be fulfilled. As before stated, we should be sure to more than compensate by extra profits for the additional quantity of machinery that must be maintained in motion. In this connection, engine friction is an important source of waste. The resistance of the engine due to internal friction of parts and the effort required for its movement at full speed, will vary according to its size, type, condition, etc. Engine friction can be assumed as nearly constant at all loads; therefore, the net results under variation in load are of great importance. The indicated work, less the friction of the engine, constitutes the net useful work, and for our purpose the net electric horse power delivered from the brushes of the dynamo is the important result upon which we base our estimate of commercial value.

While on this subject of engine friction, it will be readily perceived that, taking a compound engine under conditions of small load, it will at such time not do sufficient work to make full use of steam in the second cylinder, and it becomes possible that the friction due to moving the parts connected with the low pressure piston (as well as cylinder condensation, etc.) for many hours of small load, may more than compensate and overcome the economy gained by using the engine at its best economy for the few hours of heavy load. The same statement applies with greater force to the triple expansion engine, as in this type there is an additional cylinder with the moving parts required, practically a third engine, and the friction of the triple expansion engine is much greater than with the compound engine under similar conditions. This statement, however, must not be taken in any sense as advocating the use of the compound engine in preference to the triple expansion engine or vice versa, as I am fully satisfied that when applied under proper conditions, each will show the best relative economy. As an illustration of engine friction and its effects on commercial efficiency, I will say that I recently have made comparative tests that are interesting.

1. I tested a triple expansion non-condensing engine. The indicator cards and electrical instruments showed the following readings:

Friction cards showed........................		15.9	h. p.
The same engine tested under load of 260 amperes at 118 volts...........	41.1 Elec. h. p.		
Indicator cards showed.......	h. p. cyl.	34.9	h. p.
“ “ “	Int. “	22.0	“
“ “ “	L. P. “	12.7	“
	Total h. p.	69.6	h. p.

Commercial efficiency 59 per cent.

2. I then disconnected the low pressure piston and run-

ning gear, using the engine as a *cross-compound* non-condensing.

The readings were as follows:

Friction cards. Total friction................	9.6	h. p.

showing a saving of 6.3 h. p. in engine friction of the compound over the triple expansion engine.

3. The engine thus arranged was then tested under load, with the following results:

Under load: 235 amperes at 118 volts.....	37.17	Elec. h. p.
Indicator cards, h. p. Cyl..............	32.8	h. p.
" " Int. Cyl..............	20.8	"
Total Indicated h. p.	53.6	"
Commercial efficiency,	69.3	per cent.

This shows an increase of 10.3 per cent. in commercial efficiency of the cross-compound non-condensing over the triple expansion non-condensing.

The above results show the importance of engine friction as a factor in economy; they show how the low cylinder may drag down the engine; they do not prove that all triple expansion engines are less economical than compounds, but it is evident that in this particular instance the triple expansion engine was not so fortunately placed as to work under the best conditions. Another very important point is that it also clearly shows that even under most favorable conditions, triple expansion engines of so small a size cannot be economical. As the size of the engine is increased, its efficiency increases until we reach a capacity where the triple expansion engine surpasses the compound in efficiency. Similar comparisons may be made between simple high pressure and compound engines.

The use of compound and triple expansion engines is leading rapidly to the designing and constructing of direct driven multipolar dynamos of various capacities. The desire for direct driven armatures originally inaugurated the use of high speed engines for electric lighting.

In connection with the matter of dynamo armatures coupled direct to engine shafts, we are reminded of the fact that the original steam dynamo invented by Mr. Edison and put in operation in 1880 at Menlo Park, combined a Porter-Allen engine with the direct coupled dynamo; also that the Pearl street station of the Edison Electric Illuminating Company of New York City, started in September, 1882, was supplied with six high speed engines and direct coupled dynamos. The exhibits of the Edison Electric Light Company in the Paris Electrical Exposition of 1881, in the Crystal Palace Exposition in London of 1882, and in the Philadelphia Electrical Exposition of 1884, all contained high speed engines with direct coupled dynamos. We are thus not at this time inaugurating the application of a new type of apparatus but simply seeking to combine an improved form of dynamo with a higher economy type of engine.

What we must also recognize as a fact of great importance is, that where several units are required for generation and supply of current for central station distribution, the regulation of the dynamos must be independent of the regulation of the engines, as it is well-known that the engines cannot be depended upon to maintain absolute constancy of speed under changes in load. Each delivering dynamo unit requires independent regulation to bring its current as delivered into the system, up to the normal pressure of that system.

Mr. James Milne has severed his connection with the Keegans-Milne Co., electrical engineers of Montreal, and accepted the position of superintendent and electrical engineer of the Toronto Incandescent Light Co., a position for which his extensive experience well fits him. Mr. Milne has seen a good deal of electrical work in responsible positions, one of which was that of installing and superintending the fine exhibit of the Edison system at St. Johns, N. B., at the very successful exhibition given in that city in 1889.

A BIOGRAPHICAL SKETCH OF THE KHOTINSKY ACCUMULATOR.—VII.

BY

Capt. A. de Khotinsky

From this period dated the origin of my electrodes (Type R) for speedy charging and discharging. In the block station already mentioned I used glass instead of wood for the first time as the insulating part for the electrodes as shown in Figs. 31 and 32.

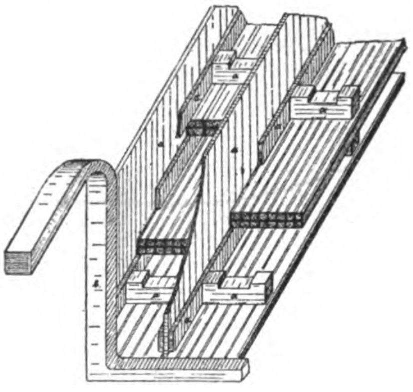


Fig. 31.

In the year 1887 the Tudor accumulators were put on the market, and they were offered at such a cheap price that my company could not compete with them, and I therefore devoted myself entirely to the manufacture of glow lamps. The rapidly extending market led us to build a large factory for their manufacture at Gelnhausen, Germany. The enormous increase of the electric lighting industry, especially in the establishment of central stations for lighting cities, which had taken place in Germany, created a demand for accumulators, and converted more and more to their use, even among those who had been its antagonists. By reason of this change the Tudor accumulator could obtain speedy and widely extended introduction under the continued raising of its selling price.

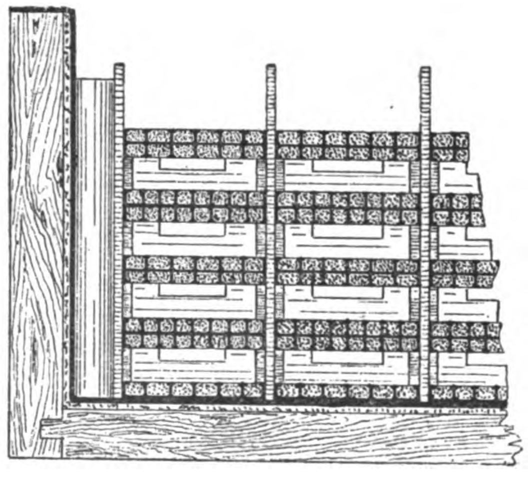


Fig. 32.

In the years 1888 and 1889 I had so developed my company's factory for glow lamps that my absolute personal attention was no longer demanded, and I had more time at my disposal. The changed conditions in the manufacture of accumulators induced my company to commission me, in the summer of 1890, with the erection of an accumulator factory of their own, adjoining our glow lamp factory at Gelnhausen, and, on account of all previous experiences with accumulators, considered themselves more warranted in taking into their own hands the manufacture of accumulators on an extensive scale.

The practice of later years had proved it to be a mistake to lay down several rows of electrodes flat over each other, because the gas, which collected at the lower part of each layer, insulated the under surface from the electrolyte and interfered with their activity. Hence the element could not deliver the capacity for which it was manufactured, and the strips had to bend. I observed this fact the first time in making a battery in Cannstadt, which was ordered for lighting a car on an Italian railroad. When I took the electrodes out of the trays from such cells as did not give the calculated capacity, it was seen that on the lower side of the negative strips in several places, but especially on the top of the connecting strip, the color was uneven and the whole electrode had bent downward, as shown in Fig. 33. At the points *a a* the color was a yellowish gray, and in scraping out the active material it was found that in those places no chemical action whatever had taken place. On examining the positive electrode I found that the strip almost always had bent upward, and only in rare instances in any other direction. Where the bend was highest no action of the filling showed itself, while the action increased in inverse proportion to the intensity of the curve. Fig. 34 shows this effect.

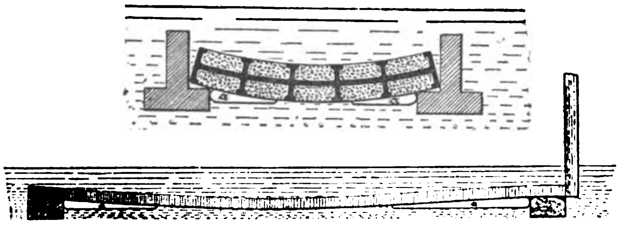


FIG. 33.

To avoid if possible, the collection of gas, I made holes in the electrode along its central line, but soon found that the gases only escaped in this way, when the perforations were made very large, even up to 8 mm. This circumstance led me to lay the electrodes on their narrow side as shown in Fig. 35. The negative electrode I soldered firmly to the inner coating of the trays while I insulated the positive by wooden strips saturated with paraffine. This arrangement I used in batteries for railroad cars, while in stationary accumulator batteries to promote the escape of gas, I either placed the whole tray at an angle of 5° to 8° from the vertical position, or laid the electrodes themselves in the trays at such an inclined angle. I could not bring about a thorough remedy by a change in the shape of the electrode, because the manufacture of electrodes was not in my hands and it was not advisable to give another method of manufacture to a strange factory.

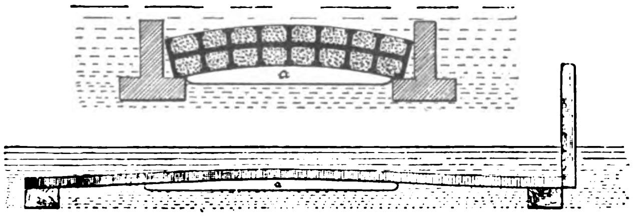


FIG. 34.

Another trouble which had shown itself was the difficulty in mounting several layers of electrodes over each other and the fact that the destroyed positive electrodes, which were always at the lowest layers, had to be removed by taking out those above them, and which were frequently broken in the operation.

The new type of my accumulator constructed in 1890 and 1891, which my company now manufactures, is the result of all previous observations and improvements; the deficiencies having been removed by many years' practice. I have given the electrode its present position on its longer edge for the following reasons: To give the forming gases the most perfect liberty to escape while charging; to insure the most even action over the whole surface; to diminish the inner resistance, while permitting the electrodes to be laid very closely together; to facilitate the mounting of the cells and the changing of consumed positive strips; to facilitate the examination of the cells.

I have constructed an electrode of several horizontal strips laid over each other for the following reasons: To satisfy the great demand for cells of greater capacity, in which the trays may always be easily handled; to avoid the warping and bending which must occur in all plates by the unequal work to which the whole surface of the plates is exposed on account of the greatly varying density of the acid in the different layers in the vessel, by fusing the horizontal strips together at certain distances from each other.

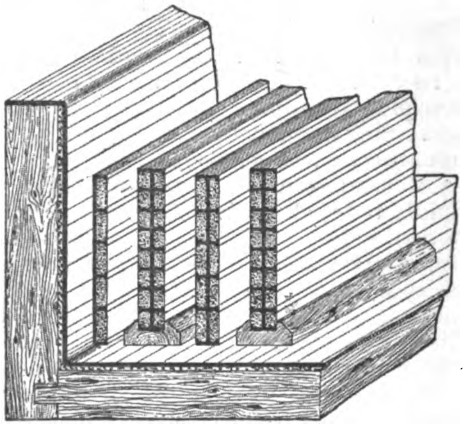


FIG. 35.

Every strip may so expand in proportion to its straining without encroaching upon and drawing the other strips with it by its own motion.

IGNITION TEMPERATURE OF ELECTROLYTIC GAS.

MESSRS. F. and V. MEYER, upon passing electrolytic gas at the ordinary atmospheric pressure through a glass tube contained in a cylinder of sheet iron, dipping into a bath of boiling zinc chloride, noticed that if the bath is set boiling and then the gas be passed, a very considerable explosion takes place at once; if the tube, however, be filled with electrolytic gas, and then introduced into the bath of boiling zinc chloride, water is formed *without* explosion. If the passing of the gas be stopped, then the bath heated to boiling point, a forcible explosion may be obtained by simply re-starting the current of gas. Determinations of the temperature showed it to be 730° Centigrade. Next, zinc bromide was taken for the bath, but with this no explosion could be obtained; the temperature in this case was 650° Centigrade. Hence the temperature of ignition must lie somewhere between 650° C. and 730° C.

MR. J. STANFORD BROWN, electrical engineer and expert, who at present is superintending the building of an electric railway at Camden, N. J., was in the city, November 8. He came home to vote, "and we hav'n't seen him since."

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

VOL. XIV. NEW YORK, NOVEMBER 23, 1892. No. 288.

Each adaptation of electricity has its special needs, which every other is bound to respect, and nothing is gained by attempts to exclude or hamper anyone of them.—E. R. Weeks.

OIL VERSUS AIR AS AN INSULATING MEDIUM.

THE recent projects of long-distance transmission of power at high potentials have served to bring out for consideration the best methods of insulating conductors, and most prominent among those proposed have been the insulating oils. These have been suggested for employment not only in connection with the well-known type of oil insulators, but also as completely surrounding the conductor placed within a tube. The claims made for oil as an insulator for high potentials have been based on a few isolated experiments, and hence any contribution to our knowledge on the actual insulating powers of these liquids as compared with air must be regarded as eminently timely and valuable. In the paper which Dr. J. B. Williams read before the American Institute of Electrical Engineers at Chicago, at its last annual meeting, not a few of the popular errors with respect to oils as an insulating medium were pointed out. The paper has now been issued. Our abstract, on another page, shows the enormous differences which may exist between the various types of oils, and even between the same oils under different conditions. While the air is shown to be superior in insulating qualities to any of the oils, its employment in general is, of course, dependent upon the condition that moisture can be excluded from the conductor. Oils themselves have been shown to be by no means unaffected by the presence of moisture, and it must, therefore, finally resolve itself into a question of comparative ability to exclude moisture, and when so considered it is probable that the oils will obtain a supremacy over air. It was to be regretted that sufficient time was not at disposal on Tuesday evening last to enter more fully into the tests of insulated wires. Dr. Williams's method is exceedingly simple and effective, and will, without doubt, be more generally used, now that its advantages have been clearly pointed out.

CENTRAL STATION ECONOMY.

MUCH has been said and written on the means for attaining the highest economy in electric central stations. The subject is one which will well bear further discussion, for, after all, the success of any industry must ultimately be gauged by the dividends which it is able to earn. In the early days of electric light and power distribution, stations were, as a rule, badly designed in the light of our present knowledge, and yet not a few of them have paid dividends and still continue to do so. On the other hand, it is hardly to be wondered at that after a lapse of a few years many of these badly designed stations have been found to be so badly handicapped, that alterations amounting practically to re-building were found to be necessary in order to maintain them on a paying basis. Wherein true economy in construction exists, and how to obtain it, may still therefore be considered a question of the greatest importance. It is from this standpoint that Mr. J. H. Vail, the well-known electrical engineer, discusses the construction of central station plants. Beginning with our last issue, Mr. Vail, whose experience in this direction has been second to none in this country, shows what things are indispensable to success, and again, what mistakes are to be avoided. The engine and boiler plants especially have received attention at his hands, and the comparisons which he draws as between the efficiency of the compound and triple expansion engines embodying the results of actual tests, bring strongly into relief the advisability of giving every detail of the plant thorough consideration before beginning construction.

LIGHTNING PROTECTION.

WHEN we consider the enormous damage which a single thunder storm can accomplish in electric light and railway power stations, it becomes a matter of the most serious consideration to afford adequate protection from lightning discharges. Recent experience has shown, however, that it does not always suffice to take care of a direct lightning discharge but that the charge which accumulates on the line by the inductive action of passing charged clouds must be taken care of if injury to apparatus is to be avoided. Again it has been shown that overhead circuits have nodal points, exactly similar to those mapped out by Hertz in his experiments with oscillating discharges and so graphically shown by Mr. Tesla in his high frequency work. The location of points for grounding circuits must therefore be made with a view of avoiding such nodal points, and the wisdom of having numerous grounding-points requires no further discussion. A device therefore, to take care of the accumulated charge, as well as an isolated and sudden lightning stroke, at the same time avoiding the dangerous nodal points, must claim more than ordinary attention, and as such the "tank lightning arrester" of Mr. Alex. J. Wurts, described in our last issue, is entitled to more than passing notice. Although but a comparatively short while in use, the results already attained with it have shown its practical value in a high degree.

ELECTRIC RAILWAY DEPARTMENT.

THE NEW PLANT OF THE BIDDEFORD & SACO RAILWAY COMPANY.

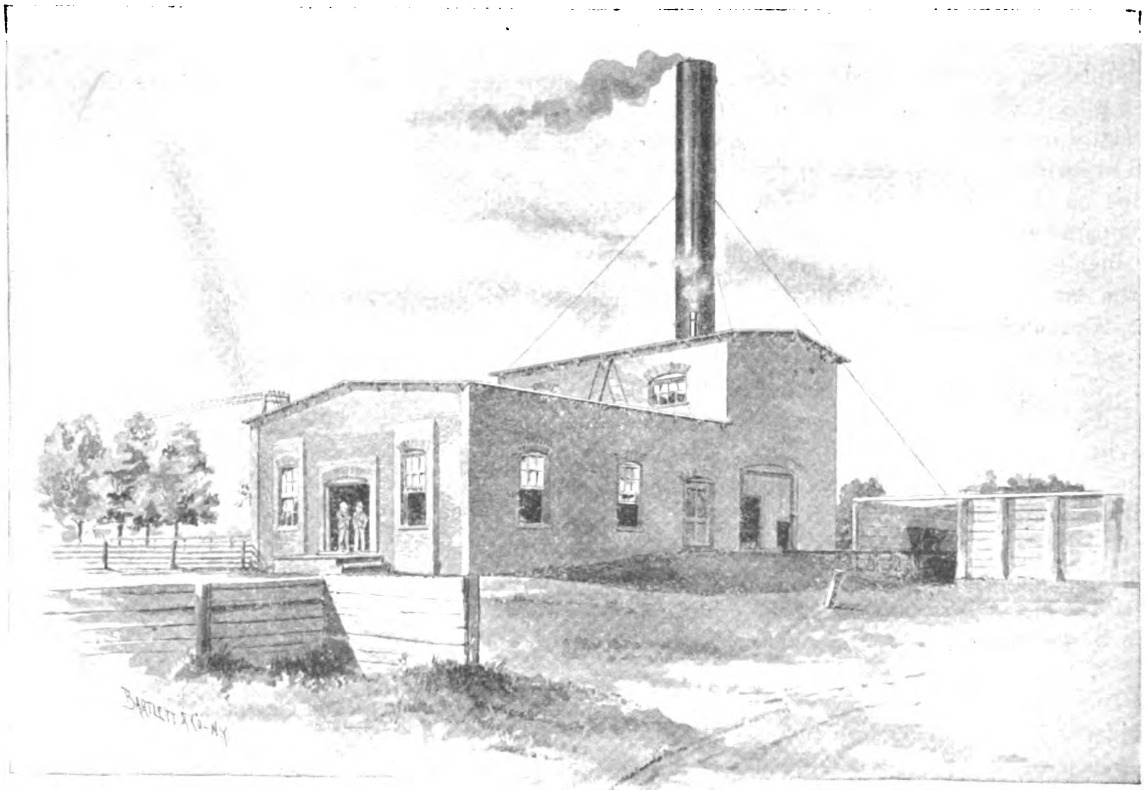
BY

A. C. Shaw.

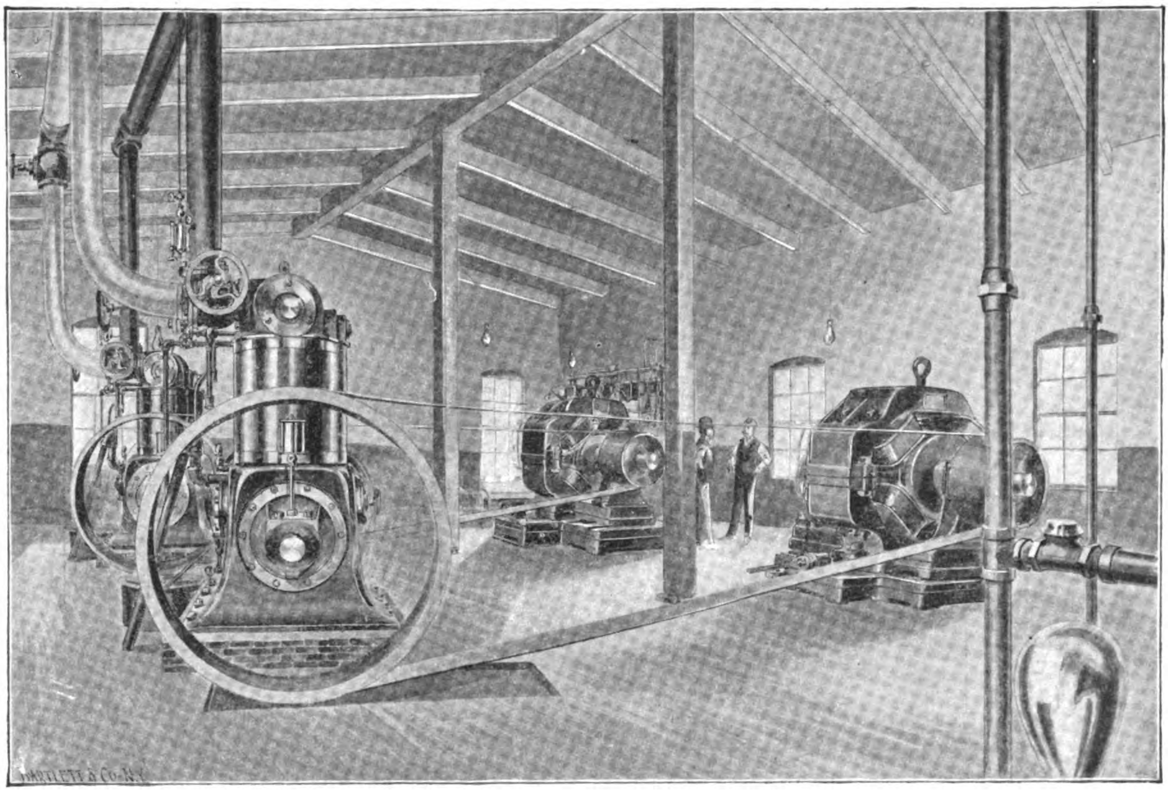
I.

THE readers of THE ELECTRICAL ENGINEER will remember a series of articles published in these columns from the pen of Mr. Wm. Lee Church, entitled "Points on Power Stations," in which Mr. Church sought to show the proper proportions of boiler, engine and generator capacity in a well designed power station, specially devoting his attention to stations of moderate capacity. These articles elicited considerable discussion, and were widely read by experienced electrical engineers, who doubtless, though perhaps differing from Mr. Church in his practice, will now be glad to read a description of a power station, the steam plant of which was entirely designed by Mr. Church, and which may be looked upon as a working example of the lines laid down by him. Such a plant has recently been installed at Saco, Me., for the Biddeford & Saco Railway Company, Messrs. Westinghouse, Church, Kerr & Company, acting as engineers for the plant, and having entire charge of the installation of the steam plant, and the General Electric Company furnishing all the electrical apparatus. Though the plant is not a large one, it bears out in a wonderful way the conclusions reached by Mr. Church in his arguments, and has achieved such a success as an economical producer of power, that an account of its construction, and a few details of the results of extensive tests will be found interesting.

The Biddeford & Saco Railway Company was organized in 1885, with a capital of $100,000, its purpose being at that time to build a horse railroad between the two towns. The charter was subsequently amended in 1887, so that rights were secured to extend the road to Old Orchard, and the road was built and opened on July 9th, 1888. As a business venture, however, the road was never a success (the bulk of traffic being in the summer time), owing to the necessity of buying horses in the spring for the summer trade, and disposing of them at a heavy loss in the autumn, when the summer traffic to the beach ceased. The question of applying electricity was agitated in 1890, and application was made to the city governments for permission to erect poles and string wires during the same year. The permits were not granted till April 7th, 1891, too late to build a station and equip the road for that summer's business, though the poles were erected and the rails bonded that fall. Soon after, a contract was made with Westinghouse, Church, Kerr & Company, for the erection of an efficient station, giving them *carte blanche* to install whatever they thought best in the way of a steam plant, and holding them responsible for its success. In the following February, 1892, the contract for the electric generators and car motors, and general electrical equipment was placed with the Thomson-Houston Electric


BARTLETT & CO. N.Y.

GENERATING STATION OF THE BIDDEFORD AND SACO RAILWAY COMPANY; SACO, MAINE.



Engine Room, Biddeford and Saco Railway Co.; Saco, Maine.

Company. The plans and specifications were all prepared by Westinghouse, Church, Kerr & Company, and the building was erected in the spring of 1892.

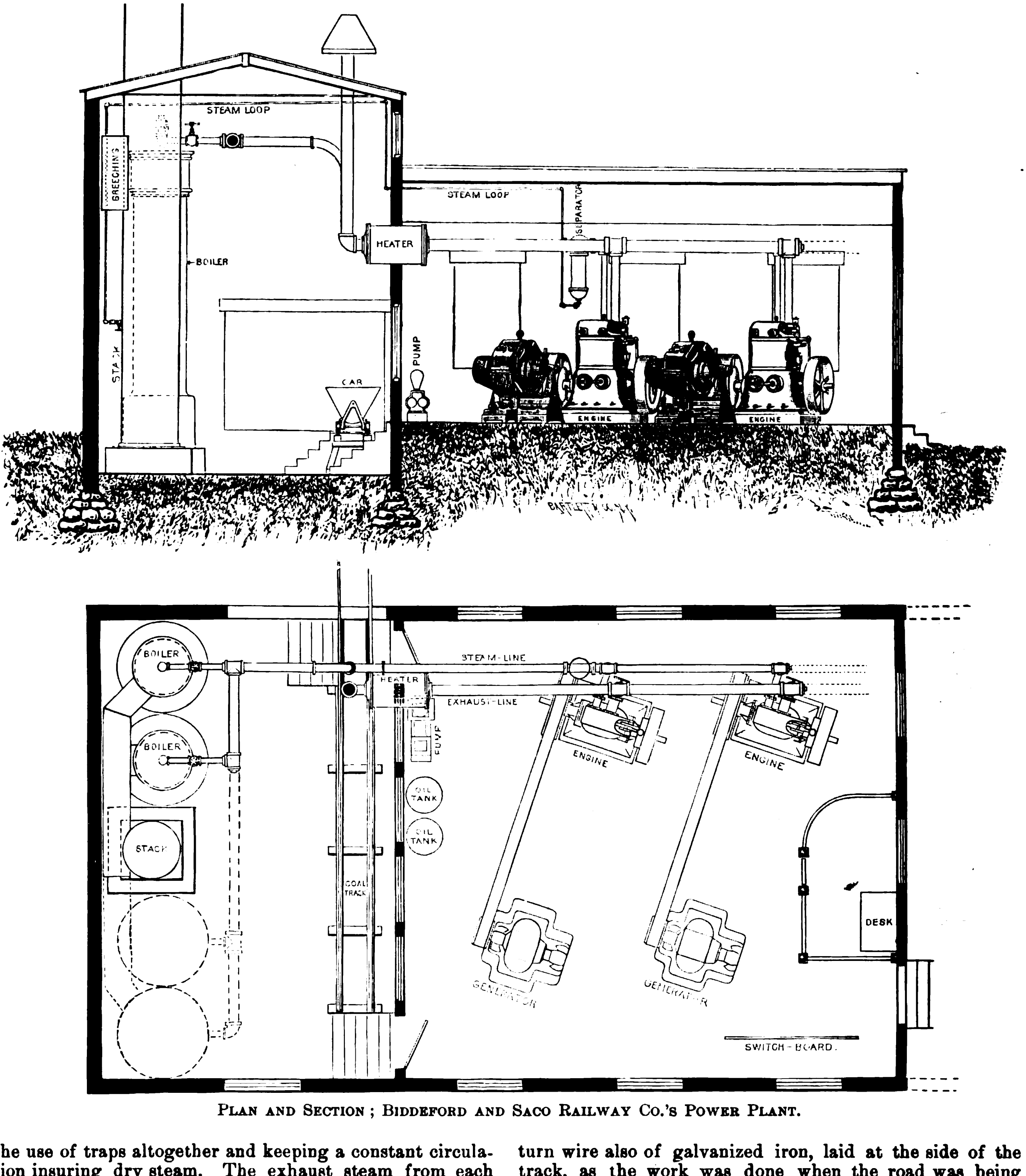
II.

The building is of brick on granite foundations and measures 62 feet long by 36 feet 6 inches wide, with ample ground facility for increasing when desired. The engine room, a ground plan of which is shown on page 496, and a general view on this page, measures 37 feet long by 34 feet 6 inches wide and is 18 feet high, having an ordinary wooden roof covered with tar and gravel. In this room are two Westinghouse compound non-condensing engines, each of 130 rated h. p. at 125 pounds steam pressure, with an ultimate capacity of 150 h. p., which run at a speed of 300 revolutions per minute. Each engine has two cylinders 12 inch and 20 inch diameter by 12 inch stroke, one driving pulley 60 inch diameter by 14 inch face, and is belted direct by means of a 12 inch double ply leather belt to the generators, the distance between the centre of the engine and generators being 18 feet. These engines are guaranteed to develop their indicated horse power non-condensing on a consumption of 25 pounds of dry steam per hour at 125 pounds pressure under full load, and 28 pounds under one-third load. As will be seen by looking at the plan, the engines and generators are set obliquely to the line of the walls, the chief reason for such setting being to economize space. By such an arrangement the main shaft of each engine can be removed at any time, should it become necessary, without interfering with the other engine, which could not be done were the two shafts in direct line with each other, except at the sacrifice of considerable floor room. It also places the commutators of the generators in such a position that the attendant can never be in danger of coming in contact with an adjacent generator, and gives generally more space about the engines and generators. The two generators are of the regular Thomson-Houston M. P. 90 type, of 120 h. p. each, furnished by the General Electric Company. The switchboard, which is of the usual skeleton type, stands in one corner of the engine-room, and is built of Southern pine. It contains the usual voltmeters, ammeters, circuit breakers, lightning arresters, and other necessary apparatus. In the engine-room is also situated a No. 4 Deane boiler feed pump, and two Hancock inspirators, and one Locke damper regulator.

III.

The boiler-room measures 22 feet by 34 feet 6 inches and is 28 feet high, with wooden roof covered with tar and gravel. It contains at present two 100 h. p. Manning vertical boilers, built by the Bigelow Company, of New Haven, Conn., of the best steel plate, rolled in a single sheet, without circular seams, and fitted with shaking grates, pop safety valves, and extra heavy gun metal mountings. The boilers are 48 inches diameter in the waist, and 65 inches diameter at the furnace, and have a total height of 23 feet 6 inches. The grate area is 18 square feet, and there are 112 tubes 2½ inches diameter and 15 feet long, having a heating surface of 791 square feet, the total heating surface being 1,138 square feet, equivalent to 11 square feet to the h. p.

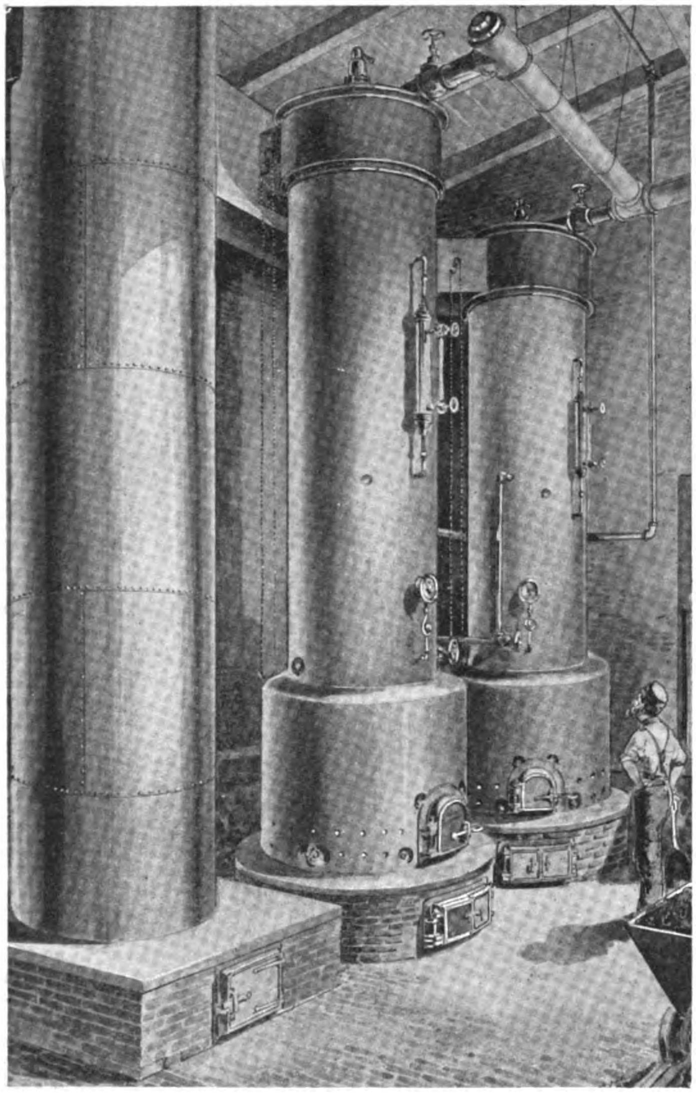
The chimney is of iron, 54 inches diameter, and 60 feet high, and rests on a cast iron plate on a granite foundation. It is connected to the boilers by the usual smoke flues, fitted with dampers, and is supported by iron guy rods. From each boiler runs a 5 inch wrought iron steam pipe, connecting with an 8 inch wrought iron steam main which is carried horizontally over the engines, and which is sufficient for double the present capacity of the station. This main passes through a horizontal separator, at the point where the connection is made to the first engine, and which is shown in our engraving of the elevation of the building. From this main drops a vertical copper bend 5 inches in diameter to each engine, having a long sweep curve to provide for expansion and contraction, and tapering in its length to bring the proper reduction of size. All steam piping is equipped with long turn fittings, and stop valves are placed in the boiler supply pipes, and at the junction of each copper main with the overhead main steam pipe, in addition to the throttle valve on each engine. All the water of condensation, primage and entrainment which is collected in the separator is automatically returned to the boilers at boiler temperature by means of the remarkable device known as the steam loop, avoiding the use of traps altogether and keeping a constant circulation insuring dry steam. The exhaust steam from each engine is carried vertically by a 7 inch pipe to a 10 inch exhaust main, which runs horizontally, at the same level as the steam main, through a 200 h. p. National feed water heater, set horizontally in the boiler-room, where it passes vertically up through the roof and exhausts into the atmosphere through a Woodbridge exhaust head.



Plan and Section; Biddeford and Saco Railway Co.'s Power Plant.

IV.

The tracks of the company, which cover a distance of six miles, are practically the same as when horses were used, the ordinary 35-pound steel T rail being still in service, while a tram rail laid on stringers is used in the vicinity of the city. These rails have been bonded with galvanized iron wire, and connected to an underground return wire also of galvanized iron, laid at the side of the track, as the work was done when the road was being operated by horses. In addition to this ground return, old gas pipe has been driven vertically into the ground at short distances along the track wherever the ground was soft enough to permit it, and the ground wire firmly soldered to it. Plates attached to the ground wire were also sunk into streams wherever such were crossed, and everything done to make the return circuit as efficient as possible, the advantage of such methods being amply borne out by the remarkably good tests which have been made on the road. The poles for the overhead construction, in the vicinity of the city, are of squared Southern pine, and on the part of the road running through the country between Saco and Old Orchard, round cedar poles are used. The poles are set 6 feet in the ground, and extend 22 feet above the surface of the road. The span wire is of silicon bronze, and the trolley wire of No. 0 hard drawn copper, held in place by the regular form of Thomson-Houston insulators. Two feeders, triple braided, run from the power house, one No. 0000 wire going to Old Orchard, and one No. 000 wire to the Biddeford end of the line. At present the company have 16 cars for service, four being 12-foot closed cars, six 25-foot open cars, and six 25-foot trailers. Each motor car is equipped with two 25 h. p. W. P. motors, built by the Thomson-Houston Electric Company, and the new type J. controller, it being of interest to know that this is the first road completely equipped with these controllers. It is also a matter of general interest that, notwithstanding the unfavorable financial condition of the company when operated by horses, as soon as the road had been operated electrically during one summer, it gave capital so much faith in the enterprise that the issue of $50,000 in bonds to cover the electrical construction was immediately taken up by local banks, and that in fact there was considerable competition to secure them. The officers of the company are as follows: E. H. Banks, president; C. H. Prescott, secretary and treasurer; and G. C. Towle, superintendent. The directors are: E. H. Banks, C. H. Prescott, Joseph Goach, J. F. Nourse, all of Biddeford; Franklin Nourse and S. S. Mitchell, of Saco; and Charles P. Pratt, of Worcester, Mass.



Boiler Plant, Biddeford and Saco Railway.

V.

Quite recently a most complete and exhaustive set of tests to determine the operative efficiency of the mechanical and electrical equipment of the station was made by the Massachusetts Electrical Engineering Company of Boston, a few details of which will be found interesting to our readers. In estimating the economy of an electric railway, and in the comparison of different roads, a fundamental factor is the operative economy of the mechanical and electrical equipment, apart from wages, interest account, etc. This is usually expressed as the cost in cents per car mile of the power expended in operating the system, and the tests which were made were undertaken for the distinct purpose of establishing this factor. The test lasted for two days, and embraced careful readings of the coal consumption, the amount of water evaporated, the indicated horse power of the engines, the electrical output of the station, and at the same time careful readings were taken by voltmeter and ammeter on the cars. The coal was all carefully weighed, and due allowance made for unburned coal found in the ashes in the morning. The water for the boilers was also carefully weighed, the exact amount pumped into the boilers being accurately determined. The engines were indicated occasionally to determine the conditions under which they were running, and the electrical output of the station was measured at intervals of one minute throughout the entire run. Every precaution was taken to operate under usual conditions, in order that the test might fairly represent an average day's run.

The net result of the two days' test may be stated as follows:

Cost of coal per car mile..........................	1.51c.
(with coal at $4.67 per ton.)	
Pounds of coal per car mile......................	7.26
Pounds of water evaporated per pound of coal, actual conditions..................	8.92

The engines, dynamos, and station equipment were in excellent shape, but the plant was not working under conditions favorable for the best economy in coal consumption, for the reason that the average load was just sufficient to make it necessary to run two engines and dynamos, but not enough to load them to good advantage.

The results in detail are as follows:

	Average of two days.
Total car miles per day...................... ..	701.
Mean electrical horse power output.............	50.
Maximum electrical horse power output.	171.
(reached only once during two days' run.)	
Pounds of coal burned per day..................	5080.
" " water evaporated per day............	45800.
" " water per pounds of coal............	8.92
" " coal per car mile....................	7.26
Cost of coal per pound........................	0.208c.
Cost of coal per car mile.............	1.51c.

The total rated capacity of the various parts of the plant is as follows:

Boilers 200 h. p. at 100 pounds steam pressure.
Engines 260 h. p. at 100 pounds.
Generators 240 electrical horse power.

This is nearly in the ratio of boilers 80, engines 104, generators 96.

The actual mean output during the test was only 50 electrical horse power, which is but 20 per cent. of the capacity of the plant.

The maximum observed electrical load was 171 horse power, which is about 242 per cent. above the average load, and but 71 per cent. of the capacity of the station.

As stated before, the most favorable results could not be expected under these conditions.

In order to determine the economy of operation under different conditions records have been kept by the superintendent in charge of the station of the coal burned and car miles run during each day. These records show that though the mean cost per car mile when running on the average of about 700 car miles a day is 1.51 cents, yet when on Sundays the traffic increased to about 1,000 car miles a day, the fuel cost was reduced to a fraction less than one cent per car mile, a result which has not only pleased the designers of the station, but which has given the most eminent satisfaction to the Biddeford and Saco Railway Company, who accepted and paid for the power plant before the maturity of the term under the contract. As for the financial returns on the investment, it is stated that in the month of July alone they earned their full annual dividend on the capital stock, assuming the road to only pay current expenses for the remainder of the year.

REGULATION OF WATER WHEELS IN ELECTRIC RAILWAY WORK.

BY JOHN A. CROSS.

In reply to the communication from Mr. T. E. Pritchard upon this subject, in your issue of Nov. 9, 1892, I would suggest that its title is a misnomer, as he describes a method of adjusting the load attached to a water wheel or wheels, and not to the regulation of the power developed by the wheels. This particular case is one of the two I referred to in a previous letter to the ENGINEER.

I would reiterate my objection to Mr. Pritchard's method, viz., that by far the larger proportion of the water powers used for electrical purposes are dependent upon a limited supply of water and cannot afford such waste. The problem is one which can be solved, as engine regulation has been, though probably not with so great a success. No one doubts the ease of adjusting the output of an electrical plant driven by water wheels running at "full gate" at all times, but this method cannot be commended for general use, though it may be a good makeshift.

Operating an electric plant driven by water, for railroad purposes, gives an excellent opportunity for the use of storage batteries. They can be connected so as to absorb power from the generators when it is not required on the circuit, and return this power to the circuit in case of sudden and excessive load. This method does not entail any waste, such as is unavoidable in Mr. Pritchard's method, though its efficiency, electrical and commercial, must be examined for each set of conditions. In addition to the above, the wheels can be materially assisted in maintaining the proper speed, by one or more fly-wheels, properly designed and located. The wheels themselves, may also, I think, be made to regulate closer than is customary at present.

Another point of equal, or greater, importance is the efficiency of the water wheels. There is a large number of wheels in every day use, most of which reach from 80 to 85 per cent. efficiency at full load, but at half load their efficiencies will vary as widely as the locations of the works from which they emanated, and anywhere from 40 to 75 per cent.

This point has a very serious bearing upon the design and operation of electric central stations, with limited water supply, and especially upon those for lighting purposes, varying in importance according to design, and the load diagram.

THE NEW YORK RAPID TRANSIT FRANCHISE.

AFTER two years of work by the Rapid Transit Commission upon the perfecting of plans for the best method of taking care of New York's enormous growth of travel, a definite conclusion has been reached, and the franchise granting the right to construct and operate the proposed road for 999 years will be sold in the rotunda of the City Hall on Thursday, December 29, at noon. The purchaser will be required to pay 10 per cent. of the bid when the sale is made, $1,000,000 in cash or good securities within the first five days as a guarantee of good faith, and the balance within thirty days. In addition to this, the successful bidder must pay the expenses of the commission, amounting to about $90,000, together with such compensation for services as the Supreme Court may determine. The company must have $50,000,000 capital stock in $100 shares, and must furnish a bond for $2,000,000 to secure the city against damage to property. That part of the road between the City Hall and 14th street is to be completed within two years; below the former and above the latter, up to 53d street, within three years; and between 59th street and the Harlem within four years after the acceptance of the bid. The road will be a four-track underground electric railway, extending from the Battery, under Broadway and the Boulevard, to Fort George, and thence to the Yonkers City line. At the southern terminus a loop will extend under State street to South Ferry and back to Broadway, under Whitehall street, and another loop will run around City Hall park, with a station at the bridge. At 14th street and Broadway a branch will run up Fourth avenue to the Grand Central Depot. There will be both way and express service, and no grade crossings. The way stations will be at short distances from one another, and the express stations about a mile apart. On the express line it is expected to make the run from Fort George to Battery park, a distance of 10½ miles, in twenty minutes. This includes ten stops.

The cost of the work is estimated at $60,000,000.

TRIAL TRIP OF THE SYRACUSE STORAGE BATTERY CAR.

THE SYRACUSE STORAGE BATTERY Co., after a long series of experiments to perfect their system, gave a public exhibition of the performance of their batteries recently on the track of the People's Line railroad in Syracuse, N. Y. The trip was made with 39 passengers, among them the following stockholders: Mayor Jacob Amos, C. W. Snow, Charles Hubbard, W. F. Pardee, C. M. Warner, Thomas Hooker, I. C. Reed, Riley V. Miller, I. Henry Danziger, A. D. Sanford, E. F. Rice, T. S. Croley, W. S. Andrews, H. P. Cady, C. L. Pack, E. L. Loomis, and Lucius Moses. The run was entirely satisfactory and steep grades were climbed with ease. On the steepest grade, one of 12 per cent. and 125 feet long, an 80 ampere fuse burned out when the car was 15 feet from the top. Two fuses, each of 80 amperes, were then tried and failed to carry the current, after which, at the risk of ruining the motor, a piece of copper wire was placed in the fuse block and the car went over the grade without difficulty or injury.

The motor used was a special Rae 30 h. p., single reduction, not wound for great speed, but making 12 miles an hour very readily, while the current was taken from 96 cells weighing 53 pounds each. The Syracuse cell is 7½x8x13 inches in size, the conducting plates are light and the rubber grids take up two-thirds of the space ordinarily occupied by liquid.

Since the first day the car has been running more or less each day, the longest run on one charge thus far made having been 72 miles over a track with few level places and many long grades. The company claim that, with their batteries, cars may be operated at a lower cost than by means of the trolley system. They are delighted with the result of the tests and expect soon to actively push the batteries in competition with those now before the public.

The officers of the company are: R. V. Miller, president; C. M. Warner, vice-president; C. S. Pack, secretary; and Lucius Moses, treasurer.

THE ADAMS ELECTRIC RAILWAY BETWEEN CHICAGO AND ST. LOUIS.

THE prospectus and statement of the Chicago & St. Louis Electric Railway Co. have been announced in the advertising columns of the daily press and it is evident that a new departure in electric railroading of greater scope and magnitude than anything heretofore attempted is actually under way. The company has secured the right of way and has already several miles under construction. Work has been commenced at Edinburgh, Ill., about eighty miles from St. Louis, and one power house is completed. The total length of the air line will be about 248 miles. The work of construction will be immediately started at the Chicago end of the route in Livingston county and built to Edinburgh simultaneously with the construction from Edinburgh to St. Louis.

In addition to generating electric energy to operate the cars carrying the mails and the passengers, it is proposed to furnish current all along the line for supplying light and power in neighboring towns and villages and operating mining machinery in the coal mines situated in the vicinity of the road. It is also intended to supply power where needed by farms.

The company is capitalized at $7,000,000, and it is its intention to open up and improve a section of the country which is rich in coal and agricultural products. The company has secured a coal belt also along its right of way which it proposes to mine and sell, using the slack and culm for running the power stations which will be situated near the mouth of the coal mines. The cars will run 10 miles apart and by a special block system any possibility of collision is, it is claimed, done away with. The road will run above all other railroad crossings, over bridges which will cost about $10,000 each, of which there are 17 in all. There will also be 248 cheaper bridges over and above its line of road at each country road crossing, and a durable fence will be built on either side of it throughout its entire length. As there will be no frogs or switches breaking the main line, nor coaling stations or water tanks, causes of delay will be minimized. The line of road is 36 miles shorter than any present steam route and it is proposed to make the run in three hours. It is the plan of the company to have four standard gauge, rock ballasted tracks, two light-weight outside tracks for local traffic and high-class freight, and two heavy-weight inner tracks for through passenger, mail and express service. The trains on the main track will run through without stop, so that leaving Chicago at 7 a. m., St. Louis will be reached at 10 o'clock. And now for the realization of this daring project!

ELECTRICITY AT THE WORLD'S FAIR UP TO DATE.

BY

H. Norman Collins.

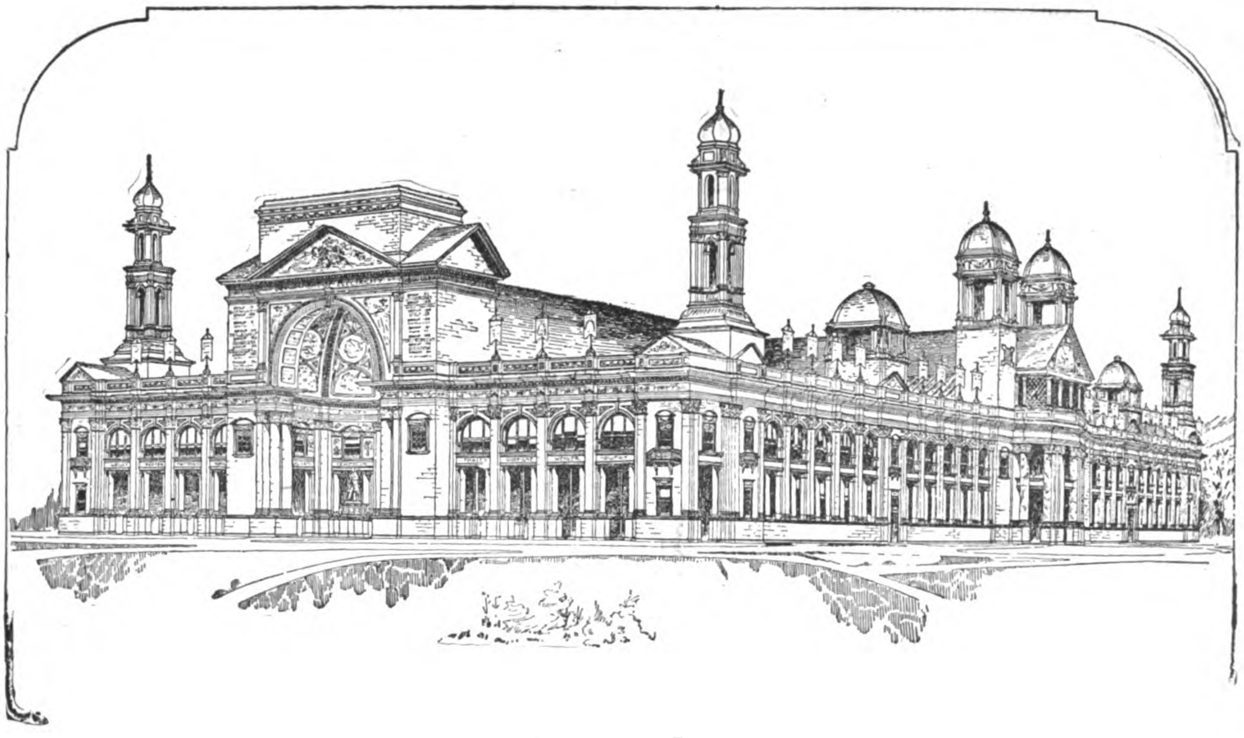
I.—INTRODUCTORY.

Statue of Franklin; Electricity Building.

THE readers of this journal are aware that, from time to time, as matters have advanced I have reported to THE ELECTRICAL ENGINEER the condition of the World's Fair, and the state of the arrangements with regard to electricity. It seems to me that the moment has now arrived when I can make a complete survey of what has been done, and speak with definiteness of plans that will be carried through. Even at this moment, there are many details still unsettled, and of no small importance, such as the question of night and Sunday opening, the lighting of certain buildings, the scope and nature of the electric fountain display; but these are matters which do not affect the accomplished work to which I shall here make reference. Part of what I shall say will naturally be by way of repetition or recapitulation, but it will help in giving a general view of the whole state of affairs.

II.—THE DEPARTMENT OF ELECTRICITY.

This department of the World's Columbian Exposition was organized in February, 1891, under the direction and jurisdiction of the National Commission appointed to control the Exposition, of which Mr. George R. Davis, the Director-General of the Fair, has been at the head. Prof. John P. Barrett, for many years with the city of Chicago as its chief electrician, was selected as the head of the department, and he, in turn, selected Mr. J. Allen Hornsby, a gentleman with an immense amount of push and energetic ability, as his secretary. He added a competent corps of assistants, and they have since the foundation of the department had the complete charge of it.



THE ELECTRICITY BUILDING.

The work of this department comprised the preparing of a complete and accurate classification of exhibits and the reception, consideration and allotment of all applications for space in the Electricity Building. It can be seen that this programme outlined an immense amount of work of a peculiarly detailed nature and requiring the greatest tact to perform to the satisfaction of everyone. It has been carried out with commendable success, and the department is as far ahead in its work as any other connected with the Exhibition, thanks to the diligence and energy of the gentlemen in charge.

Mr. Hornsby, secretary of the department, last September made a trip to Europe as special commissioner of the Exposition and visited all the principal electrical manufacturers and people connected with the industry there, giving them a full and detailed explanation of the objects, advantages and benefits to be derived from the Exhibition. The result of this commission has been that the foreign countries will make a most comprehensive and striking exhibit of all kinds of electrical apparatus, devices and appliances, for which purpose they have been assigned ample and desirable space.

The total amount of space in the Electricity Building to be allotted comprises some 245,000 square feet of ground floor space and about 95,000 feet of gallery space. It is exceedingly interesting to know that applications have been made for three times this amount of space, showing that the fears of the department that they would not have sufficient space to give everyone all they asked for in their building were not groundless. It is, no doubt, true that many exhibitors asked for more space than was actually needed by them, and the allotments have been so carefully distributed and planned that everyone will doubtless be well satisfied and have sufficient area for his requirements. Some of the difficulties of the task of distributing the space may be imagined when, of course, all the applicants naturally wanted to get the centre space on the ground floor of the Electricity Building, but all such questions as these have been handled with admirable diplomacy by the department.

At the conclusion of the dedicatory ceremonies the Electricity Building was practically turned over by the Construction Department, who erected all the buildings, to the National Commission, who will hereafter assume entire charge of it.

Among the many striking features connected with the Fair which will be installed by the Department of Electricity are two 6 foot and one 7½ foot projector search lights which Schuckert & Co., of Nuremburg, have sent to this country. These, it is said, are the largest ever constructed. If a tower is built, they will probably be placed upon it, and if not, it is said, upon the Electricity Building. Mr. Fred. Tischendorfer, representing Schuckert & Co., is now here to assist in this work.

France will exhibit several arc lights of large candle power, such as those used in light-house work abroad.

The Bell Telephone Co. will have a small theatorium, fitted with a large telephone and a trumpet in the roof so that the visitors to the exposition can listen to some of the best bands in Boston and New York.

One of the largest manufacturers of cut glass for electrical purposes will erect a Mooresque pavilion, entirely constructed of the finest cut glass of beautiful and varied hues, on the ground floor of the Electricity Building. This pavilion will be 30 feet in diameter and 75 feet high and be brilliantly illuminated by electricity.

The Department of Electricity have prepared plans and will build a model house fitted as a complete ten-room residence and equipped with every conceivable household application of electricity. Among the uses to which electricity will be put are those of cooking, washing, ironing, operating elevator, sewing machines and various forms of incandescent lighting for decorative and illuminating purposes. Speaking telephones will be installed all over the house and the lights will be arranged so that all are thrown into circuit upon the opening of the door and cut out upon closing it. The house will be warmed in cool weather by means of electrical heaters and cooled during the hot days in summer by a special refrigerating machine run by an electric motor. The special illumination in the Electricity Building will comprise some 500 arc lamps of all the various systems, there being exhibited probably in the neighborhood of some 100,000 incandescent lights.

III.—THE ELECTRICAL ENGINEERING DEPARTMENT.

The Electrical Engineering Department of the Construction Department of the World's Columbian Exposition was organized and established in the spring of 1891. The selection of a competent electrical engineer to have charge of this department was referred by a committee to the Chicago Electric Club and some five candidates were nominated for the position. From these, Mr. Frederick Sargent, one of the best known electrical and mechanical engineers in the West, who had done important work with the Edison Co. and other large concerns, was finally selected. He was appointed to the position of chief engineer of this department to be under the jurisdiction of Mr. D. H. Burnham, chief of the Construction Department. Mr. Sargent selected Mr. R. H. Pierce, a talented electrical engineer who had been connected with the Edison Co. of Milwaukee, and had held other responsible positions, as his chief assistant, and these two gentlemen, aided by a competent corps of assistants, have since had charge and carried out the work of this department. This comprised, among other duties, making plans and specifications for a temporary lighting and power plant, which was done; and a very complete station for this work was erected and thoroughly equipped. For every conceivable purpose in the construction of the buildings for which electricity could be employed, it was used, motors being employed to furnish all the power required by various machinery, which was very extensively described by me in THE ELECTRICAL ENGINEER some time ago in a special article.

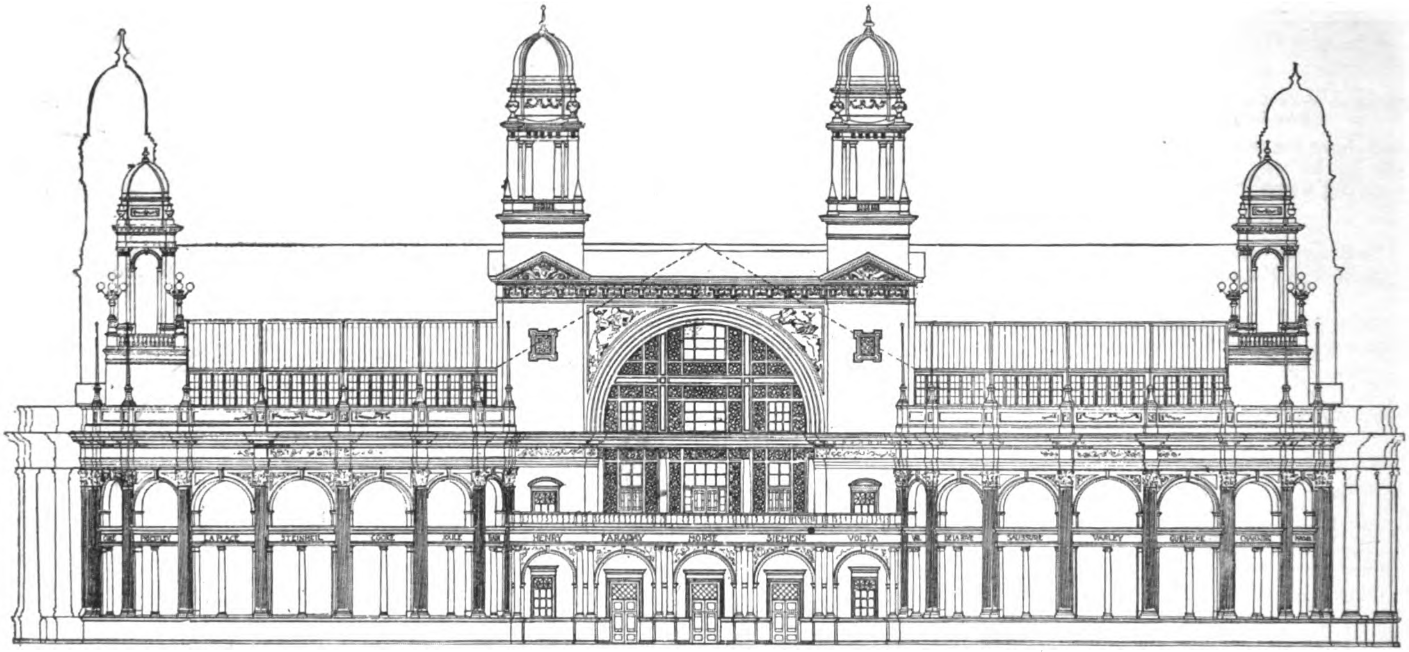
A complete fire-alarm and telegraph system was also planned and constructed and the erection of all the electrical machinery required for all purposes at the exposition during the construction, was carried out. Detailed specifications for the use of bidders for furnishing arc and incandescent lighting and electric power were carefully prepared by Mr. Sargent, and all bids for electrical machinery and apparatus of all kinds have come under his examination, to report thereon to the chief of the Construction Department.

In addition to this work complete plans were prepared for the permanent illumination of the buildings and grounds, and a very perfect and excellent system preventing obtrusive presence of wires was laid out, comprising a special subway to carry the largest number of the wires and cables necessary for arc and incandescent lighting and power purposes, arrangements also being made for putting the remainder of the wires out of sight beneath the structure of an elevated road which is to encircle the grounds and to be operated also by electricity.

IV.—THE ELECTRICAL SUBWAY.

The construction of a comprehensive subway system was designed after due consideration in such a manner as to be suitable for all purposes and at the same time to involve a reasonable cost, giving easy access to every wire for inspection and maintenance.

This subway commences at Machinery Hall and runs north as far as the Electricity Building, at which point it consists of two main sections, each being a complete subway in itself. At the Electricity Building one of the sections is divided into two branches, one running into the building and carrying all the wires necessary for supplying current there, and the other branch going into the Mining Building. The east section runs on in its entirety east as far as the north railroad bridge, where all wires cross the lagoon, and continues north the entire length of the Manufacturers' Building. At the centre of the Manufacturers' Building a section is run into the building. The east section then passes north of the Manufacturers' Building under the Government Building and into the Fisheries Building, which is the end of the subway.



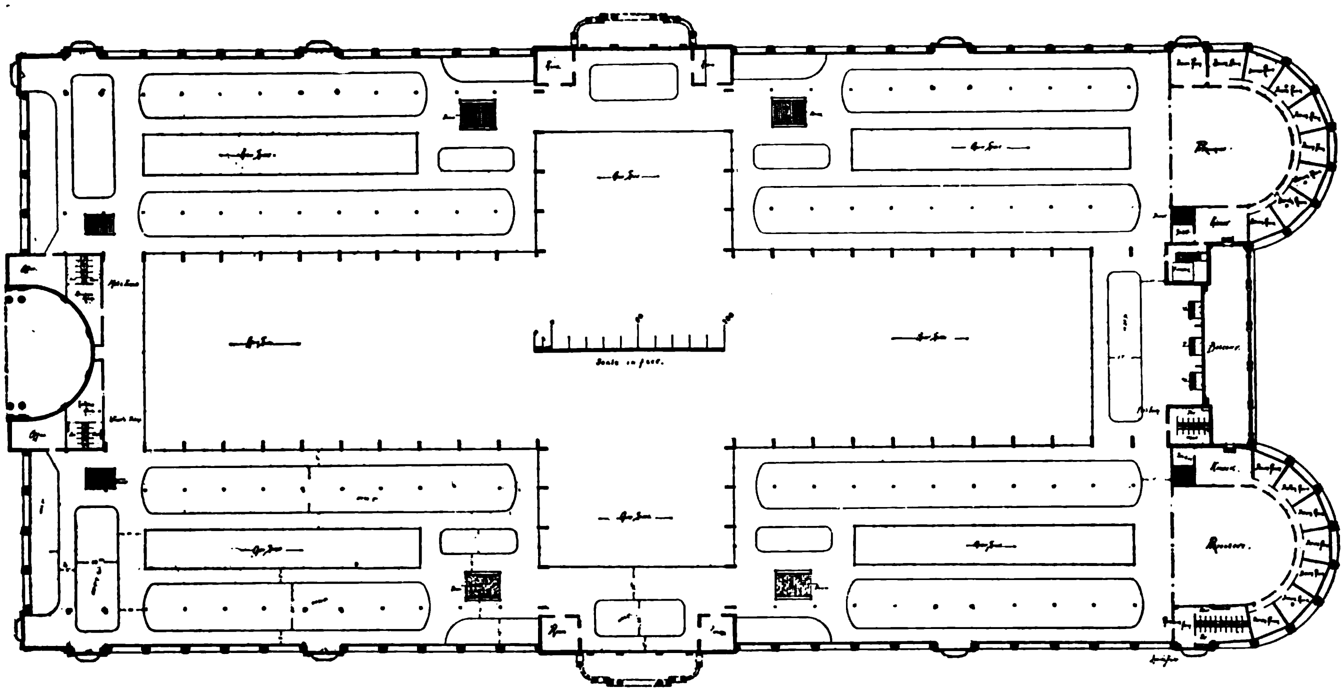
REVISED ELEVATION OF NORTH FRONT; ELECTRICITY BUILDING.

The sections are 8 feet 4 inches x 6 feet 3 inches, and in some places are reduced to 4 feet 3 inches in height, commencing at the turn north of the Government Building.

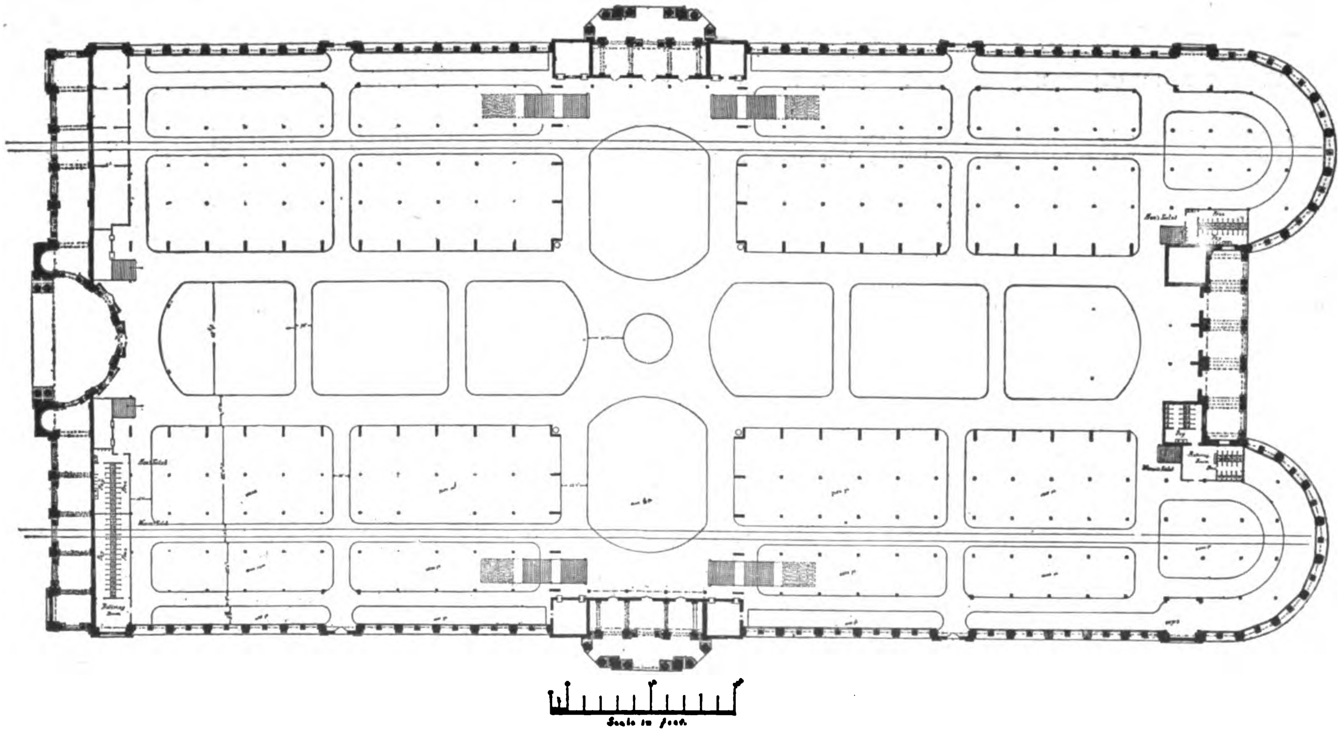
The subway is built of 3 x 8 inch joists and 2 x 8 inch planking, then covered with a metal lath and cement plastering and is lighted throughout by incandescent lamps placed in specially designed sockets made of moulded mica. At frequent intervals on the sides of the subway, cast iron uprights are let into the wall supporting tiers of oak cross-arms upon which are placed the pins carrying the insulators on which the wires are strung. Every upright has a number and also every cross-arm and every pin; and the workmen are supplied with a card of these numbers which gives them the key to every wire and shows to what use it is being put and what current it is carrying. The subway is a very substantial piece of work and is specially adapted for handling the multitude of wires that will be placed in it in the best possible manner. I have had the pleasure of walking through and inspecting it from one end to the other, and find it a very interesting trip to take.

During the recent dedicatory ceremonies a temporary plant to furnish additional lighting for the illumination of the grounds and buildings during that period was installed in the Machinery

Hall. The dynamos were manufactured by the Standard Electric Company, of Chicago, having a capacity of from four to five hundred arc lamps. Additional incandescent lighting had also been provided for. The plant was driven by Ball & Wood engines.



Plan of Gallery, Electricity Building, World's Columbian Exhibition, Chicago.



Floor Plan, Electricity Building, World's Columbian Exhibition, Chicago.

V.—ARC LIGHT POSTS.

The posts upon which the arc lights are to be placed for illuminating the grounds of the Fair will be very different from those which we see in ordinary street lighting and will emulate the beauty of design and workmanship that is so noticeable abroad, where electric lighting is done on lamp posts of architectural iron work of the most artistic and pleasing character. Some of these posts are designed to carry three lights and the others are for single lights. A contract for the single light posts of a thousand or more has been awarded to Mr. A. B. Ayers, of New York, and the work of furnishing them is under good headway. These posts are of such a height that the lamps are about 17 feet from the ground, the column being supported in a cast iron base on which is a cast iron shell 7 feet 4 inches in height. To the top of this shell is fitted a wooden pole through which the wires leading to the lamp run, and a fancy wood framework supports a handsome sheet metal hood made of galvanized iron and strengthened with iron straps connected to the iron framework. The base of all the arc lamp columns will be secured by lag screws to the wooden foundation and the contractor will erect the posts and fit the different sections together. The color which the posts are to be painted has not yet been determined upon but will be selected by the Director of Works.

Prof. Barrett reports that there will be about 1,000 electrical exhibitors, of whom 700 will be American. A great many of the exhibits will be of a very interesting nature historically, as well as technically, and alongside the latest productions of the great telegraph, telephone, electric light and electric railway companies of the present day will be placed the relics of the forefathers of the art.

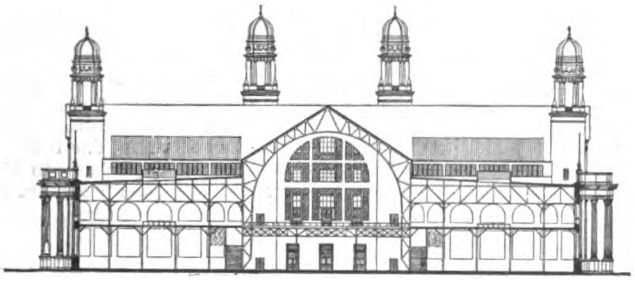
VI.—ELECTRICITY BUILDING.

The Electricity Building is now nearing completion and is one of the most handsome and imposing of the magnificent constructions composing the Exposition proper. The assignment of space in the building has now been completed, but no official authentic figures have yet been given out as to the amounts of space allotted to the different electrical industries. As regards the amount of space awarded to foreign nations, the following list is probably approximately correct:

Germany	20,000	square feet.
France	16,500	" "
Great Britain	8,500	" "
Canada	4,000	" "
Italy	2,500	" "
Belgium	2,000	" "
Austria	1,000	" "
Spain	1,000	" "
Sweden	1,000	" "
Mexico	600	" "
Russia	200	" "
	57,300	" "

It is proposed to have exhibitors furnish drawings of the display they intend making. This will enable the department of electricity to know exactly in what manner the space will be used, and to prevent any oddities or abuses.

I may add that the building is 700 feet long, and 345 feet wide. It contains 185,000 square feet of space. The nave and transept are 114 feet high. Longitudinal galleries extend along each side of the building 115 feet wide, 30 feet above the main floor. At each end these galleries connect with narrower ones. No charge is made for space. The usual regulations govern the placing of exhibits, and any special information can be obtained from the authorities.



TRANSVERSE SECTION OF ELECTRICITY BUILDING.

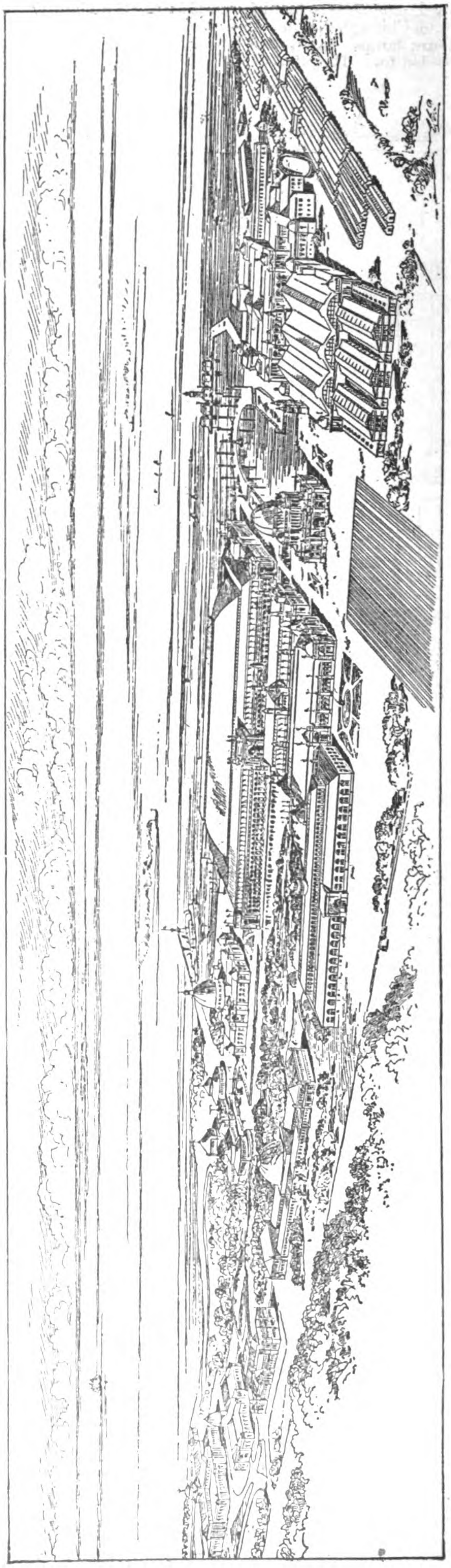
The offices of the Department of Electricity will be placed on the second floor of the Electricity Building and grouped around the hemicycle in the south end, overlooking the Administration Building.

Private rooms will be provided for the chief, assistant chief and the secretary, and apartments for the clerks and stenographers. It is hoped by Prof. Barrett, that they will be able to move into these offices shortly.

It has not yet been determined what space will be assigned to the electrical newspapers, but they will most likely be on the ground floor of the building, where some have expressed their desire to be located.

VII.—GENERATING PLANT.

The main generating plant is to be placed in the Machinery Hall, where a central plant of engines and boilers, arc and incandescent dynamos and electric railway and power generators will be placed, the plant being of a capacity to supply about 100,000 incandescent and from 5,500 to 6,000 arc lamps, and 2,500 h. p. for motors. Several electric traveling cranes will be erected in this building, slowly traversing from one end to the other and arranged for carrying passengers. Many makes of boilers and engines will be installed here, and four large Eddy power generators of 250 k. w. each will be set up. These will be driven by Phœnix engines. Several large Mather and C. & C. generators, driven by Woodbury engines, will also be located here. Sixteen 50-light Brush arc light machines driven by Ball & Wood engines are to furnish current for arc lamps, and the big Westinghouse installation comprises ten alternating current machines, as illustrated recently in THE ELECTRICAL ENGINEER, each of a capacity of 10,000 lights. Four-



BIRD'S EYE VIEW OF THE WORLD'S COLUMBIAN EXHIBITION; LOOKING EAST.

teen Ft. Wayne 50-light machines will be set up, and 20 Standard arc light dynamos, each of 50-light capacity, and 26 Thomson-Houston arc light machines of 50 lights each.

The Westinghouse Co., in addition to their furnishing all the incandescent lights, awarded them by their contract with the World's Fair, are putting in a great many lights for the special illumination of State Buildings, and will do so for exhibitors in cases where the Exposition Co. request it. The charge for this service is $12 per lamp for putting in the wires, lamp and all the work of construction and furnishing current for the same during the entire period of the Fair.

VIII.—ELECTRIC BOATS.

In accordance with the policy of the Fair officials to prevent any smoke nuisance during the exposition, it was determined to use only such boats in the lagoons for carrying passengers from one building to the other by those waterways as would be perfectly clean. While some doubts were expressed as to the feasibility of electric launches in filling the bill, specifications were prepared for them, and every bidder was required to build a boat. A trial of various classes of boats were made. Electric launches were found to do such excellent work that it was determined to use nothing else, and the contract was finally awarded by the Ways and Means Committee of the Exposition Co., acting on the advice of its chairman, Mr. H. N. Higginbotham, for 40 boats to the Electric Launch & Navigation Co. of New York, whose electric launch "Electra" was designed for the company by Mr. Frederick Reckenzaun, the well-known electrical engineer and pioneer electric boat builder of this country.

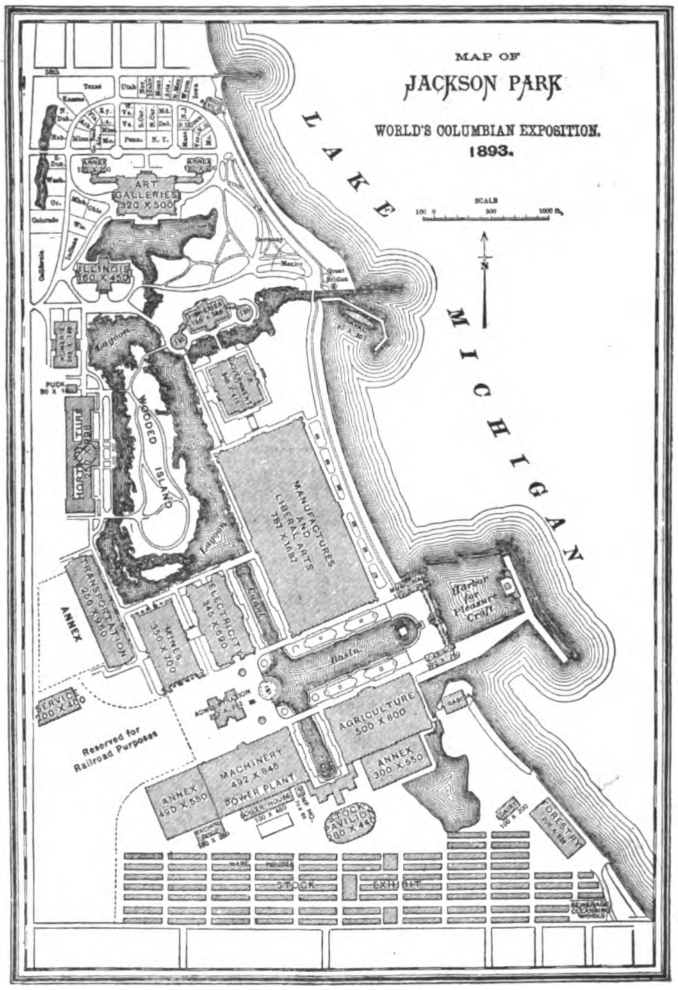
The "Electra" has been very fully described in THE ELECTRICAL ENGINEER, and is a very handsome and beautiful launch. Excellent work was also done during the trial by the electric launch built by the Columbia Launch Co. of Chicago.

IX.—ELECTRIC FOUNTAINS.

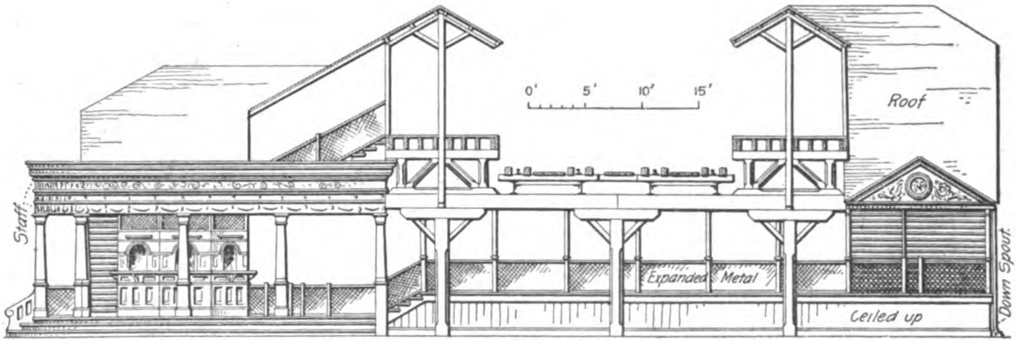
The electric fountains are to be one of the main features of the Exposition, just as electric fountains were at the Paris Exposition in 1889. Those at Chicago are to be of extremely large size, and each one will be supplied by a 24-inch water main. These electric fountains will, it is understood, be two in number, one on each side of the grand McMonnies triumphal fountain, near which the Electricity Building stands, and just adjoining the Administration Building. The work of preparing these fountains has been entrusted most wisely to Mr. Luther Stieringer, the distinguished lighting expert; and it is believed that the result will be very successful. Mr. Stieringer cares little for mere magnitude, but he will aim at producing a harmonious grouping and a beautiful effect.

X.—THE COLUMBIAN INTRAMURAL RAILWAY.

One of the most important features of the Exposition will be the elevated railway which encircles the grounds and will convey thousands of people from one part of the Fair to the other. This, like everything else about the Exposition, is to be operated by electricity, and it will serve as a good illustration to elevated railroad companies of what electric traction can do in such service. The first point about this railway is the power house, which is situated close to the Forestry Building. The main engine-room is 140 feet long by 80 feet wide; the boiler-room is 140 feet long and 50 feet wide; the construction is lumber, with a staff covering, a rear wall of brick and corrugated iron roof. In the boiler-room will be a battery of Babcock & Wilcox boilers aggregating 3,600 h. p. In the engine-room will be one 750 h. p. Allis tandem compound condensing Corliss engine, coupled direct to a 500 k. w. Thomson-Houston multipolar railway generator; one 2,000 h. p. similar Allis engine coupled direct to 1,200 k. w. Thomson-Houston multipolar railway generator; one 750 h. p. vertical Williams engine built by the Lake Erie Engine Works of Buffalo and coupled direct to a 500 k. w. Thomson-Houston multipolar railway generator; one 750 h. p. Greene engine belted direct to 500 k. w. Thomson-Houston multipolar railway generator; one 400 h. p. McIntosh Seymour horizontal tandem compound condensing engine, coupled direct to a 250 k. w. Thomson-Houston multipolar generator. All these machines generate a uniform pressure of 500 volts. The foundations for these engines are built of concrete 3 feet thick, 140 feet long and 50 feet wide, underlaid with 8 inches of timber grillage. The engine-room is so arranged as to be 10 feet above the boiler-room, and in it is placed a gallery for the public to walk around and examine the power house and machinery. A suitable pit on a level with the boiler-room is provided for five condensers and boiler feed pumps, where they are in plain view.



DISPOSITION OF BUILDINGS, WORLD'S COLUMBIAN EXHIBITION.



INTRAMURAL RAILWAY, WORLD'S COLUMBIAN EXHIBITION, CHICAGO.

The rolling stock will consist of 18 trains of three cars each, which will have a speed of from 30 to 35 miles an hour. One motor car will pull two trailers ordinarily, but is fully capable of pulling three or more if required. The motors are 40 feet long with double trucks, and four 100 h. p. single reduction special Thomson-Houston motors will be placed under each car, one on each axle. This will give an exceedingly powerful equipment.

The current for running the motors will be taken from a third rail placed between the other two, by means of a trolley wheel of special construction. It is most probable than an iron T rail fed at frequent points will be used for this purpose, but a copper rod may be installed instead. The structure of the road upon which the cars will run is being built of 12 x 12 posts supported on concrete and frame foundations. Main girders are being madeof 15-inch steel I beams upon which the ties are placed, and a rail weighing 65 lbs. to the yard. The road is a double track one, and will have frequent stations near all the principal buildings. The road is being built by the Western Railroad Dummy Co., of Chicago.

The gentlemen who are supervising and carrying out the work are Mr. C. P. Matlack, chief engineer of elevated structure; R. I. Sloane, consulting engineer of elevated structure; C. H. MacCloskie, electrical engineer; B. J. Arnold, consulting engineer and designer of the power station. Mr. Arnold, who is also the electrical engineer of the General Electric Co., in Chicago, has built some very fine electric railroad stations, notably the one at Little Rock, Ark., which is very novel and judiciously planned.

XI.—CHARGES TO EXHIBITORS.

The World's Fair authorities make a charge to exhibitors of $12 for each 16 c. p. lamp or its equivalent. This sum of $12 covers the cost of wiring, lamp and socket or current supply during the whole period of the Exposition. The $12 consists of a charge of $4 for putting in the light and of the equipments connected therewith, and $8 for the supply of current. As it is expected in the Electricity Building that most exhibitors will install their own lights, they will, in that case, only have to pay $8 for their service.

The charge per horse power for electrical energy will be $20 for ¼ h. p. during the six months of the Exposition, and $60 for 3 h. p. or over; $20 will be a minimum charge, no less amount of power being furnished. The rate for connections from motors to main line will vary from $10 to $15 per horse power in accordance with amount required. The price for arc lamps will be $60 each for the duration of the Exhibition. The rate for steam per horse power is $40 and compressed are $60.

XII.—NOTES ON WIRING.

The New York Insulated Wire Co. made a proposition to the Westinghouse Co. to furnish all wires and cables for the work on which the Westinghouse Co. had secured contracts from the World's Fair authorities. This proposition they accepted with the proviso that their wire should be satisfactory to the Exposition authorities. Grimshaw wires and cables had no trouble in settling this.

The number of incandescent lights in the Administration Building, when completed, will be 4,788 lamps; and in the Art Building, 10,066. These two buildings are nearly completed as regards the wiring. The wire in the two buildings exceeds 500,000 feet in length, and the weight of bare copper is in the neighborhood of 17 tons. The wiring on the various State buildings is progressing very rapidly. The Connecticut, Massachusetts, New Hampshire, New York, Pennsylvania, Wisconsin, Indiana and Iowa buildings are all nearly completed. Work is also being begun on the Photographic Building. The building erected by the White Star Line Steamship Co. and the Colorado Building complete the buildings upon which wiring had been begun when I last looked the ground over.

The wiring for the 5,500 to 6,000 arc lights required for the lamps on the grounds and buildings is pretty well advanced. This work is being done by the World's Fair authorities, several different makes of wire being used. All the wires will be carried in conduits beneath the elevated structure and in the subways. The ducts for the primary incandescent work have all been laid, and a portion of the wire is now been drawn in. Pumplog is used for the conduits which run from the subway, and vitrified sewer pipe under the buildings. More than 300 manholes and as many converter pits are required for the incandescent lighting.

Another item worth adding is that eight electric elevators have been contracted for to go in the Administration Building, and are, I understand, practically ready.

XIII.—THE CLASSIFICATION OF ELECTRICAL EXHIBITS.

I give below the classes into which the electrical exhibits are divided:

DEPARTMENT J.

ELECTRICITY AND ELECTRICAL APPLIANCES.

Group 122.

APPARATUS ILLUSTRATING THE PHENOMENA AND LAWS OF ELECTRICITY AND MAGNETISM.

Class 757. Statical electricity; Class 758. Thermo electricity; thermo-electric batteries; Class 759. Magnets, temporary and permanent; Class 760. Induction coils, converters, etc.

Group 123.

APPARATUS FOR ELECTRICAL MEASUREMENTS.

Class 761. Standard resistance coils; Class 762. Standard condensers; Class 763. Standard batteries; Class 764. Instruments of precision; voltmeters, ammeters, wattmeters, etc.

Group 124.

ELECTRIC BATTERIES, PRIMARY AND SECONDARY.

Group 125.

MACHINES AND APPLIANCES FOR PRODUCING ELECTRICAL CURRENTS BY MECHANICAL POWER—DYNAMICAL ELECTRICITY.

Class 765. Dynamos of direct current, constant electromotive force, varying quantity; Class 766. Dynamos of direct current, constant quantity and varying E. M. F.; Class 767. Dynamos of alternating current, constant E. M. F., and varying quantity; Class 768. Dynamos of alternating current, constant quantity and varying E. M. F.

Group 126.

TRANSMISSION AND REGULATION OF THE ELECTRICAL CURRENT.

Class 769. Cables, wires and insulation; rheostats, switches, indicators, registering meters; ammeters, voltmeters; Class 770. Safety and protective appliances; lightning rods, lightning arresters, insulators, fusible cut-outs, safety switches, etc.; Class 771. Conduits, interior and underground.

Group 127.

ELECTRIC MOTORS.

Class 772. Direct constant current; Class 773. Direct constant E. M. F.; Class 774. Alternating current.

Group 128.

APPLICATION OF ELECTRIC MOTORS.

Class 775. Street, underground, mining and other railways; Class 776. Elevators, pumps, printing presses, and general machinery; Class 777. Toys, novelties, and domestic appliances.

Group 129.

LIGHTING BY ELECTRICITY.

Class 778. The arc systems, their lamps, fixtures, and appliances; Class 779. The incandescent systems, their lamps, fixtures and appliances.

Group 130.

HEATING BY ELECTRICITY.

Class 780. For warming and heating apartments; Class 781. For heating flat irons, soldering irons, and other objects used in industrial operations; Class 782. Maintenance of constant high temperature in ovens; Class 783. Electric heating furnaces.

Group 131.

ELECTRO-METALLURGY AND ELECTRO-CHEMISTRY.

Class 784. Electrotyping; Class 785. Electro-plating, gilding and nickeling; Class 786. Electro-deposition of iron and other metals; Class 787. Electrolytic separation or metals from their ores or alloys.

Group 132.

ELECTRIC FORGING, WELDING, STAMPING, TEMPERING, BRAZING, ETC.

Class 788. Apparatus for, and methods of forging, welding or joining iron, steel and other metals; Class 789. Brazing, stamping, tempering, etc.

Group 133.

ELECTRIC TELEGRAPH AND ELECTRIC SIGNALS.

Class 790. Various systems of transmitting and receiving; Class 791. Chronographs; Class 792. Annunciators; Class 793. Thermostats; Class 794. Fire alarm apparatus; Class 795. Police telegraph and burglar alarm apparatus; Class 796. Railroad signal apparatus.

Group 134.

THE TELEPHONE AND ITS APPLIANCES. PHONOGRAPHS.

Class 797. Cables; construction and underground work; Class 798. Special protective devices; Class 799. Switch boards; Class 800. Transmitting apparatus; Class 801. Receiving apparatus; Class 802. Signalling apparatus; Class 803. Long distance systems; Class 804. Various systems of operation; Class 805. Subscriber's apparatus: Numbers, code, registers, etc.; Class 806. Phonographs. Receiving and recording apparatus; Class 807. Apparatus for the reproduction of recorded sounds and articulate speech.

Group 135.

ELECTRICITY IN SURGERY, DENTISTRY AND THERAPEUTICS.

Class 808. Cautery apparatus; Class 809. Apparatus for the application of the electrical current as a remedial agent — surgical and dental; Class 810. Apparatus for diagnosis; Class 811. Apparatus for the destruction of life.

Group 186.

APPLICATION OF ELECTRICITY IN VARIOUS WAYS NOT HEREINBEORE SPECIFIED.

Class 812. Ignition of explosives; gas lighting, etc.; Class 813. Control of heating apparatus by electricity, as applied to steam and hot air pipes and registers; Class 814. Electric pens; Class 815. Application in photography.

Group 187.

HISTORY AND STATISTICS OF ELECTRICAL INVENTION.

Class 816. Objects illustrating the development of the knowledge of electricity and of the application of electricity in the arts; Class 817. Collections of books and publications upon electricity and its applications.

Group 188.

PROGRESS AND DEVELOPMENT IN ELECTRICAL SCIENCE AND CONSTRUCTION, AS ILLUSTRATED BY MODELS AND DRAWINGS OF VARIOUS COUNTRIES.

Class 818. United States Patent Office and other exhibits of electrical models and drawings; Class 819. Foreign exhibits of electrical models and drawings.

XIV.—THE ELECTRICAL CONGRESS.

In connection with the Exhibition, a great many special Congresses will be held. One of these is the Electrical Congress, of which Dr. Elisha Gray is the chairman. A great deal of work has already been done by Dr. Gray and an Advisory Council, and it is expected that a Congress of 750 to 1,000 delegates will assemble in Chicago next August to establish new units and discuss the leading electrical questions of the day. Active and enthusiastic support is being given Dr. Gray abroad, and in this country he has secured the hearty co-operation of all the electrical societies.

A list of the electrical exhibitors, received as we go to press, will be found on page 509.

MISCELLANEOUS.

OIL VERSUS AIR AS AN INSULATING MEDIUM [1]

BY JAMES BOWSTEAD WILLIAMS, M. D.

THE instruments used in the experiments from which the results about to be set forth in this paper were obtained, were an electrometer, a discharge key, a 6-inch spark coil and a Grenet cell to operate it, and apparatus for holding the oils and other substances while they were being tested.

All of the instruments were illustrated, and the methods of using the same in making comparative tests of insulated wires explained in THE ELECTRICAL ENGINEER of March 30 and April 6, etc., 1892, in a serial by the writer, entitled "Insulated Electric Conductors." With this apparatus, using the same potential as that used in these experiments, the "dielectric after-working" of Boltzman can be demonstrated, if a few inches of a highly insulated wire are tested. The variation of the capacity of a condenser having a small bare wire for its inner coating can also be shown.

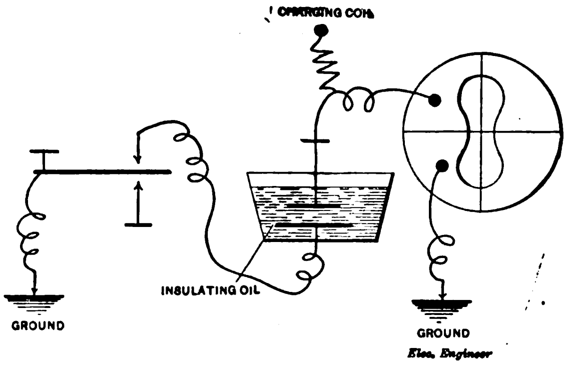


FIG. 1.—WILLIAMS' ARRANGEMENT FOR TESTING INSULATING OILS.

The apparatus in which the oils were first tested consisted of a glass cup to contain the oils and two circular brass discs, parallel to each other, which were immersed in the oil and between which layers of oil could be formed. See Fig. 1.

These discs were each 2⅛ inches in diameter, one of the discs, the lower, being fixed and the other, the upper, movable. The movable disc was soldered to the end of an adjustable screw passing perpendicularly through the centre of the hard rubber cover of the cup, which was 3 inches in diameter.

The method of testing the oils was briefly as follows: The needle of the electrometer, the induction plate, and one pair of quadrants were electrically joined to the frame of the instrument and to earth, and the second pair of quadrants joined to the upper disc.

The lower disc was connected with the binding screw of the upper contact of the discharge key, the lever of the key being depressed and held against the lower contact of the key by the trigger. The lever of the key was joined to earth. Oil was then poured into the cup, sufficient to cover the upper disc when this disk was separated from the lower disc by ⅛ inch, this being about the effective range of the screw.

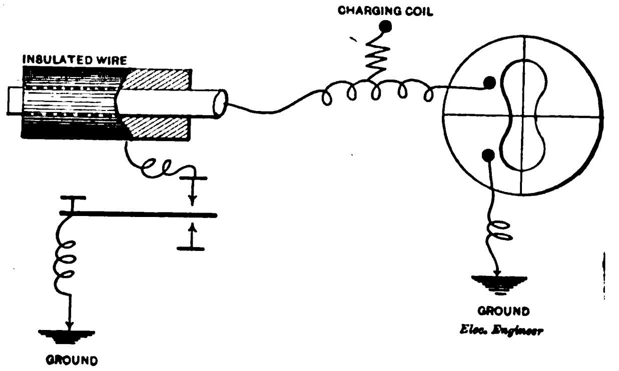


FIG. 2.—WILLIAMS' ARRANGEMENT FOR TESTING INSULATED WIRES.

The quadrants, and of course the upper disc, were then charged by sparks from the coil, to a potential of about 2,800 volts, the illuminating apparatus and scale having previously been adjusted, so that when the quadrants were fully charged the image of the cross-wire would settle at the upper end of the scale, at 300, say.

As the quadrants and discs were absolutely insulated at the potential used, there could be no leakage of the charge as long as the lower disc remained insulated from the earth; but as soon as this disc was connected with the earth, either through the medium of the discharge key or by having its electrode touched with a wire fastened to the gas pipe, leakage would take place through the layer of oil, whatever its thickness might be between the discs; and the rate at which this leakage took place was indicated by the rate at which the image of the cross-wire passed down the scale, *i. e.*, by the rate at which the electrometer was discharged.

The first set of experiments included tests of paraffin and rosin oils, air, and a specimen of a well-known insulated wire. This last test was made to show what took place when the dielectric of insulated wires was tested by means of charges of high potential, and also to make a rough comparison between specific resistance of this dielectric and that of the oils about to be tested. The temperature during the tests was 82° F., and the humidity, as idicated by a Lambrecht's polymeter, 80.

The piece of insulated wire before referred to, about five inches long, was connected with the quadrants and the quadrants charged, see Fig. 2. The edge of a pocket knife blade was then held transversely upon the dielectric, when the image passed rapidly down the scale. This experiment was repeated and the same result obtained. The ends were then paraffined and the specimen again tested. Result almost the same as before paraffining, thus showing that there had been some surface leakage at first. Many of the insulated wires now in use yield the same results when tested exactly as this present sample was tested. But there are also many which give excellent results when thus tested, and there are a few in which there is very little leakage even when several feet are formed into a condenser and tested at this same potential.

By using this method of testing, the superiority of one insulated wire over another, whenever samples a few inches long can be obtained, can easily be demonstrated. It will readily be seen that this fact may become of great importance in legal or other cases in which the comparative insulation resistance of wires is involved. Decisive results can be obtained in many cases from lengths of two or three inches only.

The second set of experiments included tests of five oils, paraffin, wax, ordinary air, and steam. The temperature was 80° F., and the humidity 75.

In this set, the layers of oil were formed between an upper disk nine-sixteenths of an inch in diameter, and a lower disc 1¼ inches in diameter. This lower disc was the flat bottom of a tin box. Its sides were covered with a thick layer of paraffin wax, so that no leakage could take place except through the layers of oil. The discs were absolutely insulated from each other and from earth.

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[1] Abstract of a paper read at the General Meeting of the American Institute of Electrical Engineers, Chicago, Ill., June 8, 1892.

1. Paraffin oil was first tested in a layer ¼ of an inch thick, but the falling of the image was too rapid to be accurately noted. A layer ⅛ inch thick was then tested and gave a fall of 207 divisions in one minute.

2. Rosin oil tested in a layer ¼ of an inch thick, gave a little better results than the paraffin oil; but when a layer ⅛ inch thick was tested, the fall was 177 divisions in one minute. In these two tests of the two oils all effects due to the drop were eliminated by repeated chargings, so that the fall due to leakage alone was noted.

3. Linseed, cotton-seed and castor oils were each tested in ⅛ inch layers, but as the fall of potential was so much greater than that of the other two oils no further tests were made of them.

Of the three, castor oil had the lowest specific resistance; and there was but little difference between the linseed and the cotton-seed oils, what little difference there was being in favor of the linseed oil.

4. A layer of paraffin one sixteenth of an inch thick and free from air bubbles, was next formed between two tin discs, each 1⅝ inches in diameter, and tested like the layers of oils. When the ground circuit was closed the drop was just five divisions. The quadrants were again fully charged, and the falling of the image noted. This fall was one division in two minutes, or 30 divisions in one hour.

5. A brass tube 10 inches long and five-sixteenths of an inch in diameter was next used for a receptacle for oil. In the centre of this tube was a straight copper wire one-sixteenth of an inch in diameter, the wire being kept concentric with the tube by means of two hard rubber plugs with holes through their centres. The tube contained rosin oil. The wire was connected with the quadrants, and the tube absolutely insulated from the earth and neighboring objects.

The quadrants were then charged and the tube grounded. The image passed down the scale too rapidly to have its rate of falling timed. The hard rubber plugs were carefully paraffined so that all of the leakage took place inside the tube.

A torrent of sparks was poured into the electrometer, but it could not be charged on account of the rapid leakage through the oil.

6. Three plates of glass each 3 by 4 inches and one-eighth of an inch thick, were carefully cleaned and then dried over a lamp. Before they had cooled, one was covered with a film of rosin oil, one with a film of paraffin oil, each film having an area of about two square inches, and the third had a film of paraffin wax about one inch square formed on it. A No. 20 copper wire was fastened to the quadrant electrode, and its free end placed in contact with the centre of the film on the glass. The glass was insulated and the quadrants charged. The image remained stationary as long as the glass was insulated, but as soon as any conducting body, the hand for instance, came in contact with *any* portion of the glass plate, leakage over the film of material on the glass occurred. In each case there was a slight drop, but the quadrants were immediately recharged. The rate of falling of the image with the glass plates covered with the oils was practically the same, the fall being about five divisions to the second; but with the paraffin wax the image remained stationary. Repeated chargings failed to alter the rates of falling of the image.

7. The last tests were made with air and steam, and in both tests the layers were formed with the device used to ascertain the potential of the fully charged quadrants. In the first of these tests, the disks were separated a trifle more than .03 of an inch. The drop in this test was just two divisions, but after that the image did not move in 20 minutes. The writer has made this same kind of test in former years, and has allowed the instruments to stand for hours, and yet there would be no leakage through the layer of air.

The last test was made with a layer of steam of the same thickness as the layer of air in the test just described. The quadrants were fully charged and the ground circuit closed. Steam was then generated in a test tube and the mouth of the tube held directly beneath the discs. This enveloped the disks in steam and also formed a layer of steam between them. As soon as the layer of steam was formed, leakage took place through it, and the leakage increased as moisture was deposited upon the discs (thereby reducing the distance between them) until a bridge of water was formed, when, of course, the quadrants were immediately discharged. From many tests, the writer found that, as nearly as he could determine, the rate of fall, when the layer was composed entirely of steam, was about 20 divisions in one second.

From a careful consideration of the foregoing tests, the results thereof appear to the writer to prove, when continuous high-tension currents *alone* are concerned:

1. That air, even when it has a humidity of 80 per cent., is infinitely superior to oil for insulating conductors carrying such currents. 2. That pure paraffin is far superior to oil, both for insulating conductors and for preventing the escape of the current across the surface of glass. 3. That air having a humidity of 80 per cent. is superior to paraffin as an insulating medium. 4. That oil will not prevent leakage of the current across the surfaces of glass. 5. That whenever oil covers the surface of hard rubber, even when the latter is paraffined, it destroys the high surface insulation of the paraffined hard rubber, that is, the low surface insulation of the oil has been substituted for the higher surface insulation of the hard rubber, when used bare and clean, or when covered with paraffin.

The writer would state that the results of the present tests, which were made in New York City, correspond substantially with results obtained by himself and his brother, Mr. R. W. Welty, while they were making the investigation of insulating material and its applications, which is now being described in the serial before referred to.

A few words relative to the use of the oils in practice, may not be amiss here. To use oil for insulating conductors, there must be an enclosing vessel of iron, or its equivalent, for the oil and conductors. If long tubes are employed for this purpose, two things are indispensable—plugs in the ends of the tubes and means for keeping the wire or cable concentric with the tube, and the individual wires of a cable separated from each other. For the latter purpose, fibrous material is probably the most convenient means. Jute, when pure and dry, is an excellent fibre, both for the oils when used alone and when thickened with rosins, etc., for by reason of the peculiar nature of the fibre, a larger amount of insulating material can be placed within a given space than if a closely-lying vegetable fibre is used; and there will also be fewer points of contact of fibre between the wires and the inside of the tubes. Experiments made by the writer show that there is but little difference in the specific resistance of different kinds of vegetable fibre when the fibre is clean and absolutely dry. The resistance of such fibre is high as long as it remains in this condition. But it is almost impossible to keep it so. It may be a matter of surprise to many to learn that cotton which has been dried, and which therefore possesses good insulating properties, loses these properties in less than 10 minutes if exposed to a damp atmosphere. Whatever means are used for the purpose last above stated, they should have a high specific resistance and allow the use of as much oil as possible.

The plugs must be formed of insulating material which is not injuriously affected by the oils. The best hard rubber, or some special vulcanized rubber or gutta percha compound, appears to be the best for this purpose. Paraffined wood is very apt to be of little use in a short time, owing to its absorptive moisture by capillary attraction.

All oil should be carefully heated, sufficient to expel all moisture and air before it is used. If paraffin oil is used, it is better to subject the oil to a comparatively low temperature and exhaust the air by means of a vacuum than to heat the oil to a high temperature. After the moisture has been removed, the oil must be kept excluded from the air or it will again absorb moisture.

If oil is used as a covering for insulators made of inferior glass or porcelain to be of value it must contain no moisture or dirt; and if used in damp and dusty localities, means must be provided for the self-renewal of the oil, so that fresh surfaces of oil may constantly be exposed. But if insulators had surfaces formed of glass which contained a large proportion of pure silica, better insulation would be effected, if these surfaces were not covered with oil. The writer once found a molded glass vessel, having about the same dimensions and area as the "pony" insulators, which had a surface insulation vastly superior to that of the "pony" insulators. If insulators were made wholly or in part of *such* material a covering of oil would be worse than useless, for experiments have shown that when glass or other material does prevent surface leakage, covering it with oil at once ruins the high surface insulation.

Expansion should be taken into consideration when using these oils in pipes, for if the pipes are full and the oil gets heated, it will expand and probably either expel the plugs or exude at the ends. If it exudes, dust and moisture will collect upon the film of oil and cause surface leakage. This leakage at the ends of pipes containing telephone or telegraph wires, might not be detrimental to the working of the lines, but if the pipes contained wires carrying high-tension currents, serious trouble might arise.

The efficiency of oil to fill holes in dielectrics depends greatly upon circumstances. If the holes or gaps should be formed in the dielectrics of wires conveying weak currents, the oil, if not too sluggish, would have plenty of time to move into and fill such spaces; but if in the dielectrics of wires conveying strong currents, the oil must move very quickly or a disastrous burn-out is the result. And not only this, but the oil, becoming hot expands, and the pipes, if of lead, are apt to be strained or broken by the increased pressure from within, outwards. If the burn-out occurs near the ends of the pipes, the plugs may be expelled. If the filling of spaces were the *only* thing required of the oils, the lighter ones would accomplish this purpose better than the denser ones. But the heavier oils—*e. g.*, heavy and light paraffin oils—are much better for insulating purposes than the lighter.

In conclusion, the writer would state that he feels warranted in believing, unless the contrary can be demonstrated, that dry air, if employed to form a portion of the dielectrics of insulated conductors and if the conditions upon which its highest efficiency depends are fulfilled, is an insulating material superior to oil and even paraffin. Certainly air is cheaper than any other insulating material, and it is not destroyed or injured by intense currents. Burn-outs do not affect it, and if it can be kept dry, which is the great difficulty attending its use, the conductors which it insulates will have a high insulation resistance, and a low electrostatic capacity—two things which are of the greatest importance in electrical engineering.

LETTERS TO THE EDITOR.

THE COMPARATIVE EFFICIENCY OF THE EXTERNAL RESISTANCE AND COMMUTATED FIELD RAILWAY CONTROLLING SWITCHES.

In my "stricture" on Mr. Reid's article on the above subject, it was my intention to simply discuss his argument and not to teach fundamental principles, and as I could see no connection between his "basic" (?) assumption and this argument, I made no comment upon it. For if we follow Mr. Reid, through his juggling of turns and resistances, we bring up at our original speed, with an *increased* field, which surely shows that he had not started (in his argument) with a field equal to the constant, maximum field, which I hope Mr. Reid knows is used with the external resistance, though he now claims to have done so.

That he should claim that I start my argument from a different basis than his own is entirely unwarranted, for we both started from an immediate point. That I did is understood, while that Mr. Reed did is evident from the fact, that having made his changes and regained his former speed, he could certainly by simply weakening his field to its former value increase this speed.

The essential difference between our reasoning was, that I argued for an increase of speed, by both methods pure and simple, while he decreased his speed by a commutated field and then increased it by means of an external resistance, and drew from it a conclusion which fully repaid the experiment. Though by what method he could double his field turns and decrease his resistance I am at a loss to understand.

I can only think that Mr. Reid does not fully understand the inter-relation of speed, field and current in the two methods. And it is somewhat of an imposition upon me and upon the space of this journal that Mr. Ried should ask me to prove that the commutated field varies inversely as the speed and is therefore less intense than the constant maximum external resistance field, except at least speed, and that we should not compare our motors at greatest speed, when the commutated field is weakest, while the external resistance field has remained for all speeds at a constant maximum.

Noting this spirit in Mr. Reid, I beg to refer him to Kapp's "Transmission of Energy," or the "Electric Railway," by Crosby & Bell, for the proofs of what I give him credit for already knowing.

Harold R. Wellman.

WIRING FRAUDS IN NEW YORK CITY.

I noted with considerable interest an article in a recent numcer of your paper in regard to Mr. Low's experience on the Pacific coast with an electric light wireman. It would perhaps be very interesting reading to publish the names in full, and give the buildings in which wiring has been placed in this very city reflecting no very great credit to the so-called electrical engineer that installed the wires.

One case which I can mention exactly corresponds with Mr. Low's experience; that is, a so-called electrical engineer equipped one of the finest residences in this city with electric light wires, presumably using the Grimshaw white core wire. But the underwriters were not such fools as the so-called electrical engineer thought they were, and he had the pleasure of rewiring the building. His method of construction was to place a cheap grade of insulated wire under the floors and in the walls, etc., but wherever the wires were exposed to view, that is, at the various outlets, he very calmly stripped off the cheap insulation, and slipped on pieces of Grimshaw white core insulation. I would advise our mutual friends, the Grimshaw people, to make their white core wire so that it cannot be stripped, and thus made to cover the faults of a cheaper grade of wire.

I trust that your energetic and upright journal, now that this question on dishonest wiring has again been started, will keep the fight up until the architects and owners are made to realize the fact that it requires brains and experience, as well as integrity of character to get good work. It is almost impossible to convince architects that they do not know any more about electric light wires than all the rest of the community put together, and architects are the ones who should he held by the owner of every new building financially responsible for poor electric light equipments.

Insurance Expert.

New York City, Nov. 17, 1892.

ELECTRICITY ON THE FARM.

Your editorial in a recent issue of The Electrical Engineer, on "Electric Motors for the Farm," bears directly upon some work that I did at this college last Spring, an illustrated account of which appeared in the columns of the Engineer, June 1st. As far as I know, this was the first application of the electric motor to *farm work*. This plant has been in successful operation since April 15th, threshing oats, wheat, rye and barley, cutting up silo, grinding up corn, and ginning and pressing cotton.

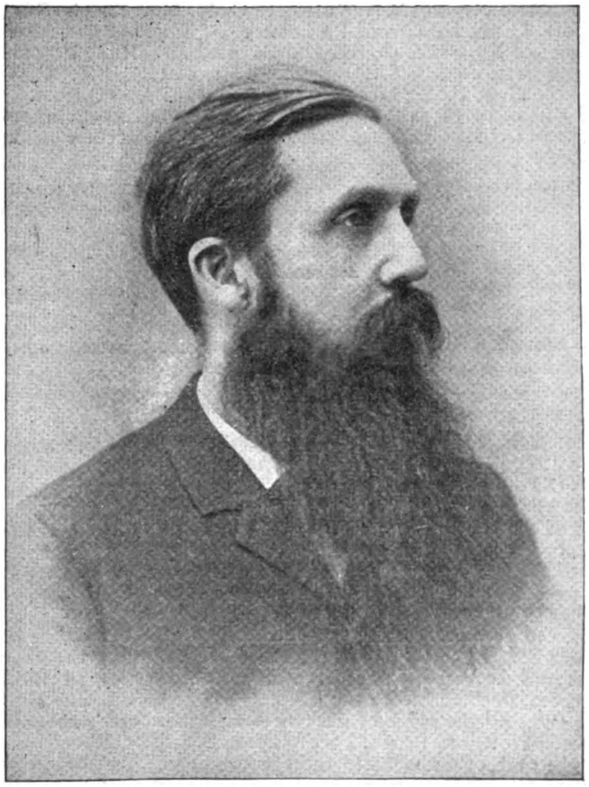
A. F. McKissick.

Alabama Polytechnic Inst., Auburn, Ala.

PERSONAL.

JOHN R. MARKLE.

In the spring of '81, Mr. John R. Markle, then residing in Chicago, made the first out-and-out sale of an isolated incandescent plant to Norton Bros., the owners of the flour mills at the Madison street bridge. This was a small 15-light incandescent machine made by the Edison Co. Previous to this time, Mr. Markle had turned his attention to the question of electric lighting, and having faith from the first in its commercial adaptability, was not afraid to enter into its promotion, although at the time he could hardly have appreciated the difficulties with which, as a pioneer, he was to meet. He then went to Michigan and sold the first plant in the State to a saw mill at Ludington, Mich., this being also a small 15-light machine, the only size at that time manufactured by the Edison Company. In Detroit he put in the first stationary electric motor, to run a shop for shoe manufacturing, and finally succeeded in capitalizing the first central station companies in the West having any considerable investment for low tension direct current constant potential electrical distribution. Since that time Mr. Markle has been continuously connected with the electrical business, and he has now associated himself with the great German company of Siemens & Halske in America, to manage what is known as the central district, comprising the States of Ohio, Michigan, Indiana, Kentucky, Tennessee, North and South Carolina, Florida, Georgia and Alabama, with offices corner Race and 5th streets, Cincinnati, Ohio. With him is Mr. Harnish, late president of the Peninsular Electric Co., of Grand Rapids.



John R. Markle.

MARRIED.

GRAHAM—PHELPS.

HELEN LAPHAM PHELPS, daughter of Mr. and Mrs. George M. Phelps, was married at her parents' house in Brooklyn, N. Y., November 17, 1892, to George Wallace Graham, of Minneapolis, Minn. The ceremony was conducted by the Rev. Stephen H. Camp, of the Third Unitarian Church, at 12 o'clock, in the presence of the immediate families and near relations, and three girlhood friends of the bride.

After the marriage a wedding breakfast and reception were held from 12:30 till 2 o'clock p. m., during which many friends came to offer their congratulations. During the wedding and reception delightful music was played by a detachment of Anton Seidl's orchestra of four stringed instruments headed by Mr. John Cheshire with his harp. Everything was of the most informal and unconventional character. There were no bridesmaids nor best man, the bride being attended by her father and mother only. The ushers for the reception were: William L. Fort, George Phelps Fort and Harvey Crissey, all cousins of the bride. Among the wedding guests and those present at the reception were: Dr. and Mrs. Schuyler S. Wheeler, Miss Virginia Fitz-Randolph, Mr. and Mrs. T. Commerford Martin, Mr. Joseph Wetzler and Mr. George Barton Muldaur, of New York; Mr. and Mrs. Oscar Pfeiffer, Mr. and Mrs. James Young, Mrs. Caleb Shepard, and Mr. Fredrick O. Pierce of Brooklyn, N.Y.; Mr. and Mrs. C. Stoddard, Mr. and Mrs. Walworth Cady, Miss Phoebe Stoddard and Mrs. Laura Hewitt, of Plattsburg, N. Y.; Rev. and Mrs. Olin Hallock, of Norwalk, Conn., and Dr. and Mrs. R. F. Benson, Jr., Mr. and Mrs. Joseph A. Powers and Mr. and Mrs. M. M. Waterman, of Troy, N. Y.; Mr. A. C. Shaw, of Boston, Mass. Soon after the close of the reception Mr. and Mrs. Graham started westward for Minneapolis, where they will make their home.

LEGAL NOTES.

THE EDISON—SAWYER-MAN CASE.

EDISON ELECTRIC LIGHT COMPANY AND EDISON GENERAL ELECTRIC CO. *vs.* SAWYER-MAN ELECTRIC CO.

Defense of the Sawyer-Man Company.

THIS case, adjourned November 4–11, 1891, came up for hearing before Judge Lacombe, Friday, November 18, 1891, in the United States Circuit Court, on a motion for a preliminary injunction.

The allegation that the complainants are a monopoly, in violation of the Sherman Anti-Trust Law, was the defense offered. Clarence A. Seward, Grosvenor P. Lowrey and R. N. Dyer are counsel for the Edison interests, and Edmund Wetmore, Elihu Root and Leonard E. Curtis for the Sawyer-Man Company, which supplies the Westinghouse Company with lamps.

Mr. Curtis, in arguing for his side, resisted the granting of any injunction on the ground that the complainants are violating the Anti-Trust Law. He read an affidavit from George Westinghouse, Jr., declaring that the General Electric Company substantially owns all the stock of the two complainant companies, of the Thomson-Houston, Brush, Fort Wayne, Schuyler, Excelsior, Van Depoele and other electric light companies. The affidavit declares that the General Company is trying to get a monopoly of the whole business of electric lighting, and, on the strength of the Court of Appeals decision, is trying to prevent the Westinghouse Company from making and selling dynamos. The decision applies only to lamps. Mr. Westinghouse said that the General Company people told the World's Fair directors that his company could not supply lamps, so that it might not get the contract to light the buildings.

Mr. Westinghouse says he has invented a lamp which does not infringe the Edison patent. By January 1 he will be able to manufacture it in sufficient quantities to supply his trade.

Upon the opening of Court Saturday, November 10, Judge Lacombe stated to counsel that his time was very fully taken up in the near future by other causes, that he would not be likely to reach a decision in this case at a very early date, and in view of the importance of the question at issue and the magnitude of the interests involved suggested that the suit be referred to the U. S. Appelate Court which would convene in this city, December 6.

His Honor's suggestions was accepted by counsel for both sides and an order was agreed to accordingly. The agreement included the issue of a preliminary injunction and a stay of the same till the session of the Appelate court, December 6, and a further stay from that date provided the defense be then ready to proceed with the argument of the case. This disposition of the suit leaves the whole matter in *statu quo* until December 6.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED NOVEMBER 8, 1892.

Alarms and Signals :—

Electric Railway Signal, A. J. Wilson, Port Chester, N. Y., 485,728. Filed Feb. 29, 1892.

An automatic block signal for steam railways.

Thermostat and Alarm, G. Fischer, Chemnitz, Germany, 485,739. Filed July 20, 1892.

Claim 1 follows :

In a fire-alarm, a flat spring held, against its normal tendency, in a strained position by a hard coating or sheet of gelatine.

Railway Signal Apparatus and System, J. W. Lattig, Easton, Pa., 486,047. Filed Aug. 18, 1892.

An automatic electric lock signal for steam railways.

Water Indicator for Boilers, W. H. Rodgers, Bay Side, N. Y.. 485,054. Filed May 21, 1892.

Distribution :—

Electric Transmission of Power, E. W. Rice, Jr., Lynn, Mass., 485,658. Filed Sept. 18, 1891.

Comprises at both generating and receiving stations direct and alternating current machines, the receiving station having its machines mechanically connected and having a connection seperable from the current mains and leading from the direct current machine to the field of the alternator.

Electric Transmission of Power, E. W. Rice, Jr., Lynn, Mass., 485,659. Filed Sept. 18, 1891.

Invention consists in causing a single direct current alternating machine to first act as a motor, to start the main motor, and then as a generator driven by the main motor, and feeding the field currents thereof.

Dynamos and Motors :—

Design, 21,981, *Electric Motor Frame*, B. D. Southard, Chicago, Ill. Filed June 20, 1892.

Lamps and Appurtenances :—

Manufacture of Carbon Filaments, T. A. Edison, Llewellyn Park, N. J., 485,615. Filed Dec. 15, 1886.

Manufacture of Carbon Filaments, T. A. Edison, Llewellyn Park, N. J., 485,616. Filed Dec. 15, 1886.

Employs carbonized asphaltine for the filament.

Incandescent Lamp Filament, T. A. Edison, Llewellyn Park, N. J., 485,617. Filed July 17, 1888.

The method of making carbon filaments from asphalts or hydrocarbon residues.

System of Lighting Railway Cars and Platforms, D. B. Nichols and C. L. and C. A. Cotton, Dedham, Mass., 485,647. Filed Sept. 7, 1891.

Employs a lamp at each end of the car both on the same side, a switch for each lamp and reflectors arranged to distribute the light along the steps and side of the car.

Incandescent Electric Lamp, A. C. Carey, Lake Pleasant, Mass., 485,682. Filed June 15, 1892.

Employs couplings for the leading-in wires and filaments composed of tubes constructed between their ends and applied to the ends of the wire by crimping.

Electric Arc Lamp, G. Kirkegaard, Brooklyn, N. Y., 485,744. Filed May 13, 1892.

Employs a train of wheels for feeding the carbon and an escapement wheel mounted in a separate stationary frame, pivoted concentrically with the escapement wheel so that the centre of gravity of the latter will remain constant while that of the frame is shifted.

Electric Arc Lamp, J. R. Steers, New York, 485,895. Filed May 28, 1892.

Has for its object to simplify the construction and arrangement of focusing lamps.

Measurement :—

Voltmeter, E. R. Carichoff, Richmond, Ky., 485,896. Filed May 12, 1890.

Makes use of the heating instead of the magnetic action of an electric current so that the elevation of temperature is measured by expansion.

Metal Working :—

Electric Forge, G. D. Burton, Boston, Mass., and E. E. Angell, Somerville Mass., 486,029. Filed Dec. 22, 1891.

An electric forge in which the electrodes for supporting the bars to be heated may be readily adjusted for different lengths and thicknesses of metal.

Miscellaneous:—

Apparatus for and Process of Refining Copper by Electricity, F. Farrel, Ansonia, Conn., 485,618. Filed April 26. 1892.

Rheostatic Controller for Electric Motors, J. P. B. Fiske, Lynn, Mass., 485,619. Filed Feb. 5, 1892.

A rheostatic controller having a rheostat connected to the armature of a shunt-wound motor, a short circuit connected to the field magnet and containing a circuit breaker and a circuit reverser in the field magnet connections.

Electric Motor Controller, J. P. B. Fiske, Lynn, Mass., 485,620. Filed Feb. 5, 1892.

Employs a permanently closed continuous circuit including in series the resistance and the field magnet and armature of the motor, and a rheostatic switch connected with the resistance and motor.

Electric Clock, J. D. McAnglis and H. E. Fleming, Beaver Falls, Pa., 485,645. Filed June 7, 1892.

Continuous Current Transformer, E. Thomson, Swampscott, Mass., 485,669. Filed Aug. 28, 1891.

Comprises a rotary transformer having an armature whose winding is connected through commutating devices to the circuit, and a secondary winding connected to independent commutating devices, and additional commutating devices rotatable relatively to the aforesaid commutating devices, and connected with a separate circuit and with a secondary winding.

Electric Belt, E. N. Tefft, Iola, Kans., 485,754. Filed July, 30, 1892.

Electric Perforation Pen, A. D. Lewis, Canton, Mo., 485,767. Filed June 30, 1892.

Method of Magnetically Separating Ores, T. A. Edison, Llewellyn Park, N. J., 485,841. Filed July 20, 1892.

Has for its object to eliminate the sulphur from concentrated iron ores where the original ore contains magnetic pyrites.

Method of Magnetic Ore Separation, T. A. Edison, Llewellyn Park, N. J. 485,842. Filed July 20, 1892.

Designed for the treatment of low-grade nickeliferous pyrites ores to recover the nickel therefrom and also the cobalt, gold, copper, and other metals that may be present.

Manufacture of Mandrels for Electrolytic Deposit of Tubes, F. E. Elmore, Leeds, 485,919. Filed Aug. 12, 1891.

Automatic Electric Scale, P. J. Kohbacher, Ashland, Ky., 485,950. Filed Mar. 24, 1892.

Railways and Appliances :—

Electric Railway Switch, C. A. Stone and E. S. Webster, Boston, Mass., 485,668. Filed Oct. 30, 1890.

Has for its object to control the track switches directly from the moving car, by means of a supplemental trolley and overhead conductor.

Switches and Cut-Outs :—

Switchboard for Electric Light Circuits, J. J. Moore and D. A. Henry, 485,643. Filed April 9, 1890.

Invention consists in providing two sets of wires at right angles to each other, one set connected to the dynamos and the other to the circuits, each set being provided with contact devices placed opposite to similar devices in the other set.

Telegraphs:—

Telegraph Sounder, J. Maret, Mt. Vernon, Ky., and W. L. De Graff, Homer, Mich., 486,051. Filed Aug. 4, 1891.

Telephones and Apparatus :—

Telephony, W. Bruening, East Orange, N. J., 485,859. Filed Aug. 1, 1891.

Employs a receiver, consisting of a closed hollow vessel containing a fluid and provided with dashers in movable contact with the fluid, one provided with a spring and each of the others with a diaphragm.

Telephone, J. W. McDonough, New York, 485,876. Filed July 21, 1884.

Employs a vibratory body having electrical conductors arranged parallel to one another over its whole surface; the conductors being vibratory and imparting their action to the body.

ELECTRICAL EXHIBITORS AT THE WORLD'S FAIR.

FOLLOWING is a list of those whose applications for space in the Electricity Building at the Columbian Exhibition have been granted: [See article on "Electricity at the World's Fair.]

Amateur Electrician; American Bell Telephone Co.; Anthony Elec. Instrument Co.; Arnold Elec. Mfg. Co.; American Exhibition Co.; American Graphophone Co.; Adler, Leon D.; Akron Elec. Mfg. Co.; American Tanning Co.

Bain Elec. Mfg. Co.; Brooks, R. T.; Brooks, John C.; Brush Elec. Co.; Bryan, Enholm & Co.; Billings & Spencer Co.; Belknap Motor Co.; Bottome, Turner D.; Berliner, E.; Brady, T. H.; Barton Bell Co.; Blodgett Mfg. Co.; Butler Hard Rubber Co.; Beacon Vacuum Pump & Elec. Co.

C. & C. Elec. Motor Co.; Cutter, George; Crocker-Wheeler, Elec. Co.; Consolidated Elec. Storage Co.; Commercial Cable Co.; Cook, Victor A.; Cobb Elec. Wire Co., of Wilmington, Delaware; Chicago Society of Operative Electricians; Chicago Magnetic Shield Co.; Commercial Elec. Co.; Columbia Incandescent Lamp Co.; Central Elec. Co.; Cross, Frank; Cregier, DeWitt C., Jr.

Davy Elec. Belt & Appliance Co.; Duplex Elec. Co.; Dayton Fan & Motor Co.; Devey, Matthew H.; Du Laney Clock Co.; Detroit Elec. Works; Day, S. A.; Delaware Hard Fibre Co.

Elec. Merchandise Co.; Electrical Supply Co.; *Electrical World;* Eureka Elec. Co.; Elgin Telephone Co.; Empire Gold & Silver Plating Works; Engineering Equipment Co.; Eureka Tempered Copper Co.; Electrical Industries Pub. Co.; Edgerton, N. H.; Electric Gas Lighting Co.; Electrical Forging Co.; ELECTRICAL ENGINEER; *Electrical Review;* Electricity Newspaper Co.; Electric Secret Service Co.; Electric Eng. & Supply Co.; Elec. Heat Alarm Co.; Eddy. Elec. Mfg. Co.; Elec. Advertising & Display Mfg. Co.; Elec. Machine Co.; Elec. Appliance Co.; Excelsior Elec. Co.; Egan, Chas. E.; Empire China Works; Electrical Age Publishing Co.; Electro-Medical Battery Co.; Edgerton, E. M.; Electrolibration Co.; Edison, Thos. A.

Field Engineering Co.; Fibre Pipe Co.; Ft. Wayne Elec. Co.; Ford-Washburn Storelectro Co.; Franklin Elec. Appliance Co.; French, H. W. & John Warren.

Guillaume, Alfred; Gray, Elisha; Greeley, The E. S. & Co.; Goodwin, F. O.; General Electric Co.; Gamewell Fire Alarm Tel. Co.; Germania Elec. Co.; Great Western Elec. Supply Co.

Hanson & Van Winkle Elec. Co.; Heisler Elec. Co.; Hirlimann, Chas. J.; Hornell Iron Works; Hall, Chas. Fred.; Huestis, Chas. D. C.; Holmes, Nathaniel L.; Houlehan, James; Hope, Elec. Appliance Co.

Interior Conduit & Insulation Co.; India Rubber Comb Co; International Elec. Ry. Co.; Illinois Alloy Co.; Indiana Insulated Wire & Rubber Co.

Jenney Elec. Motor Co.; H. W. Johns Mfg. Co.; Johnson Elec. Co.

Kirwin Elec. Indicator Co.; K. A. P. Elec. Novelty Co.

Lang, J. & Co.; La Roche Elec. Works; Le Clanché Battery Co.; Leatheroid Mfg. Co.

C. McIntire Co.; Munson Lightning Conductor Co.; Marcus, Wm. N.; Moore, Alfred F.; Mather Elec. Co.; Mather, A. C.; Munson Belting Co.; Municipal Fire & Police Tel.; Mason, Jas. H.; McCaskey, Alfred S., & J. A. Ellis; Manhattan Elec. Supply Co.

New York Insulated Wire Co.; National Elec. Mfg. Co.; Newman Clock Mfg. Co.; Norwich Insulated Wire Co.; New England Butt Co.; North American Elec. Co.; New York & London Elec. Ass'n.; National Carbon Co.

Owen, Dr. A.

Perkins, Frank C.; Paiste, H. T.; Page Belting Co.; Pumpelly, Jas. K.; Pennock Battery, Elec. Light & Improvement Co.; Perkins Elec. Lamp Co.; Phœnix Glass Co.; Praul Rotary Steam Engine Co.; Phelps, A. H., M. D.; Wm. Powell Co.; Perry & Runlett; Pulvermacher Galvanic Co.; Pratt Electro Medical Supply Co.

Quin, J. B.; Quinby, Wm. C.; Queen & Co., Jas. W.

Railway Equipment Co.; Ravell, Alex.; Rich. Elec. Heating Co.; Rogers, J. Harris; Ries Elec. Specialty Co.; Roessler & Hasslacher Chemical Co.; Rauscher, John; Robinson Machine Co; Ringler, F. A. Co.; Riker Elec. Motor Co.; Ries, Elias E.; Rosseau's Elec. Works.

Sperry Elec. Mining Machine Co.; Standard Underground Cable Co.; Sponholz, Carl L.; Short Elec. Ry. Co.; Swan Lamp Mfg. Co.; Standard Paint Co.; Striemer, A.; Siegler, Jas. O.; Steward Mfg. Co., The D. M. Strowger Automatic Telephone Exchange; Sample, H. C.; Sarony, H. J.; Stanley Elec. Mfg. Co.; Schieren, Chas. A. & Co.; Standard Elec. Signal Co.; Standard Battery Co.; Sanden Elec Co.; Stoelting, Christ. H.

Thermo. Elec. Heat Regulating Co.; Thomson-Houston Elec. Co.; Ticonderoga Machine Co.; Thomson Elec. Welding Co.; Todd, John T.; Thompson & Robertson; Tompkins, Mrs. Jennie E.; Tropical American Tel. Co.; Tate.

Utica Elec. Mfg. and Supply Co.; Union Elec. Works.

Vetter, J. C. & Co.; Vail, Stephen; Viaduct Mfg. Co.

Western Elec. Co.; Weston, Wm. H. & Co.; Writing Tel. C.; Washburn & Moen Mfg. Co.; Waterhouse Bros.; Western Electrician; Weston Elec. Instrument Co.; Westinghouse Elec. & Mfg. Co.; Western Union Tel. Co.; Wing, L. J.; Waddel-Entz Co.; Webb, Dr. G. F.; Wiesinfeld, Robt. S.; Woods, Granville T.

Zucker & Levett Chemical Co.

NEW ISSUE OF GENERAL ELECTRIC BONDS.

A DISPATCH from Boston of Nov. 15 says:—The General Electric Company will issue a circular offering common shareholders the right to subscribe for $6,000,000 additional 5 per cent. bonds at par, making the total issue $10,000,000. There is $30,067,200 common stock, and the allotment will be in the ratio of one in five. The outstanding bonds sold last week at 104 and are now 102, so that not much value attaches to the right. The issue has been underwritten for a small commission, which is a practical gratuity to the underwriters, as the bonds would naturally sell themselves. It is announced that the proceeds are required for working capital.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

AT the monthly meeting of council, held November 15th, the following associate members were elected:

Arnold, Craig R., electrician and treasurer, Arnold Electric Mfg. Company, Chester, Penn.

Bohm, Ludwig K., Ph.D., consulting electrical and chemical expert, 81 Nassau street, New York City.

Durant, Edward, electrician with F. Pearce, 115 East 26th street, New York City.

Gale, Horace B., consulting electrical and mechanical engineer, 40 California street, San Franciso, Cal.

Hunting, Fred S., electrical engineer, Fort Wayne Electric Company, Fort Wayne, Ind.

McElroy, James F., mechanical superintendent, the Consolidated Car Heating Company, 131 Lake avenue, Albany, N. Y.

Stahl, Th., Creusot Works, Creusot, France.

The following associate members were transferred to full membership, their applications having been approved by the Board of Examiners:

Bourne, Frank, electrical engineer, Field Engineering Company, 143 Liberty street, New York City.

Thomas, Benjamin F., professor of physics, Ohio State University, Columbus, Ohio.

Wurts, Alexander J., electrical expert, Westinghouse Electric & Mfg. Company, Pittsburg, Pa.

Metcalfe, George R., electrical engineer, editor, *Electricity*, New York City.

Stillwell, Lewis B., electrical engineer, Westinghouse Electric & Mfg. Company, Pittsburg, Pa.

At the meeting of the institute in the evening, Dr. J. B. Williams made a series of tests of the insulating qualities of different oils, referred to in his paper read at the Chicago meeting of the institute. The insulation of samples of various wires was also tested, and the use of his apparatus was fully explained. Dr. Williams had an electrometer mounted on the lecture table, and the spot of light was reflected on a scale pinned to the wall. The members were thus able to follow his demonstrations very closely.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

A good advertisement keeps off wrinkles, and is better than a hair restorer.

THE PENNSYLVANIA ELECTRIC ENGINEERING CO.

The excellent and thorough work done by the Pennsylvania Electric Engineering Co., of Philadelphia, has naturally resulted in the acquisition of large contracts throughout the country. One of the most recent of these is in the new Philadelphia & Reading Railroad terminal depot in Philadelphia and consists of a lighting plant comprising 300 Western Electric arc lights, 10 Western Electric dynamos and the entire construction work.

The company has issued a handsome lithograph of the depot, which is said to be not only the finest building of its kind in the world, but one of the most handsome public buildings in America. The building occupies four city squares, is fireproof and cost, together with the elevated tracks, upward of ten million dollars.

MR. PAUL T. KENNY.

The representation of Mather dynamos and motors was recently taken in this vicinity by Mr. Paul T. Kenny, who has been in the field as an electrical contractor and engineer for some time, and who now has his offices in the Bennett Building, Nassau St., this city. Mr. Kenny reports having sold the *New York Herald*, for its new building on Broadway and West Thirty-fifth street, four Mather generators of 450 amperes each; one 40 h. p. Mather motor and two of 20 h. p. each. This apparatus is to be delivered by January 1. Four other recent contracts secured by Mr. Kenny are a 1 h. p. motor for J. B. Hecker, optician, Brooklyn; a 3 h. p. motor for T. F. Larkin, printer, Brooklyn; a 15 h. p. for the Jennings Lace Works, Brooklyn; and a 10 h. p. to C. H. Jones & Co., printers, New York City. Mr. Kenny sees plenty of good business ahead.

THE JENNEY ELECTRIC MOTOR COMPANY.

The well-known Jenney Electric Motor Company, of Indianapolis, Ind., are complaining that orders will persist in coming in so rapidly that the demand exceeds the supply, and they are under the painful necessity of enlarging the works and increasing facilities. Their "Constant Pressure" power generators are meeting with high favor, as are also their lighting and plating dynamos. The company are also contractors for complete light and power plants.

WESTERN NOTES.

New York Insulated Wire Co.—In the office of the New York Insulated Wire Co., at No. 80 Franklin street, Chicago, is in operation one of the most novel electric lighting plants in the country. The current is furnished by a dynamo, driven by an arc circuit motor, both installed by Mr. Chas. E. Gregory, the well-known dealer in dynamos, motors, etc., and the wires are encased in Vulca ducts from the dynamo to the lamp, the circuits being laid out so as to show a complete distributing system of Grimshaw white core wire in Vulca duct, with all the necessary appliances in the way of junction boxes, fishing boxes, elbows, etc., and any wire can be disconnected and taken out from the lamp to the switchboard. Among the novelties used in the construction of the plant are the Electric Engineering and Supply Co.'s sockets, switches, etc., the Cutter Electric Mfg. Co.'s flexible brackets, and the Sunbeam incandescent lamps. Mr. Geo. H. Meeker cordially invites all who are interested, especially architects, to inspect this model plant. A constant source of attraction is an illuminated picture of the grounds and buildings of the World's Columbian Exposition, showing Grimshaw white core wire in Vulca ducts, lighting all the incandescent lamps. Every architect or electrician should inspect this plant, as it is an exceedingly interesting one.

Messrs. A. M. Morse & Co., contracting engineers, Commercial Building, St. Louis, Mo., have closed contracts during the past month for a number of Buckeye engines, boilers and complete power outfits for central stations, and isolated plants at Monticello, Ind., Spring Valley, Ill., Fulton, Mo., Springfield, Mo. and Kansas City, Mo.

J. Lang & Co., 44 Michigan street, Chicago, are in receipt of numerous orders for their Lang and Andrew switches, which have a high reputation and are prime favorites among electrical people for carrying heavy currents. They use the best material in their construction and the workmanship is also most excellent.

The Railway Equipment Co., Pullman Building, Chicago, have just closed two extensive contracts with the Cincinnati Street Railway Co., and the Cincinnati & Covington Street Railway Co. for overhead supplies, line material, etc. These contracts were secured in the face of keen competition and are both for a very large amount of material. The volume of electric railway supply business being handled by this company is exceedingly extensive, and the quantity of goods being shipped every day from their store is an impressive sight.

The Electric Appliance Company have just closed arrangements with the Whitney Electrical Instrument Company, of Boston, to handle their celebrated line of test instruments in the West. The Whitney has already established a reputation for accuracy and ability to stand rough usage wherever it has been in use. It is also particularly neat in appearance. The Electric Appliance Company will carry a large and complete stock, and push them extensively in the West.

The Chicago Electric Manufacturing Co., 73–75 West Jackson street, Chicago, are very busy and doing a good business. They manufacture a fine line of electric and combination fixtures and also electrical apparatus of various kinds and do all sorts of electrical work. Since Mr. E. R. Crolius assumed the management of the company, their business has largely increased.

The Osborne Steam Engineering Co., 167 Dearborn street, are building several power plants for electric work. They have now in the course of construction the plant for the Pabst Heat, Light & Power Co., of Milwaukee, which is of 2,000 h. p. capacity. Mr. Osborne, engineer of the company, has carried out a large number of important power and heating contracts.

Mr. Osgood, agent for the Premier Steel Co., of Indianapolis, Ind., is now settled down in his new quarters in the Manhattan Building, Chicago, and is busy introducing their new electric elevators for which many novel and advantageous features are claimed; and also taking contracts for the well-known hydraulic elevators manufactured by this company.

Mr. Edw. R. Grier, 1522 Monadnock Building, Chicago, is agent for the new switch manufactured by Russell & Officer, of Denver, Colo., enabling the lights to be controlled from any one or any number of points. It can also be used for controlling current from any distant point for any electrical translating device such as a motor, lamp, etc.

The Bain Electric Manufacturing Co, 47 South Jefferson street, Chicago, have their shop full of orders for dynamos, motors and mining machinery. They are making quite a specialty of electrical machinery for mines and are constructing some fine electric locomotives for this purpose.

The Mosher Arc Lamp and Manufacturing Co., of 127 Ontario street, Chicago, are enjoying a brisk run of trade on their Mosher arc lamps for constant potential circuits, both direct and alternating. Present auguries tend to show that they will do an immense business with their new alternating lamp.

Rattenburg & Jones, electrical contractors. 435 Rookery Building, Chicago, are doing a general contracting business installing electric lighting plants complete, electric bells, gas lighting and burglar alarms. They also deal in fixtures.

Mr. Geo. McKinlock, of the Central Electric Co., Chicago, spent a very pleasant time while abroad this summer. He visited Ireland, Scotland, England and Paris and made some interesting inspections of electrical work during his trip.

The Chicago Incandescent Lamp Co., No. 75 Clinton street, manufacturers of the Pray incandescent lamp, have received some reports of recent tests of their lamps which speak very highly for their durability and efficiency.

Geo. Meeker, Chicago manager of the New York Insulated Wire Co., says that his business is continually on the increase and Grimshaw wires and cables are holding their own in a very gratifying manner.

The Great Western Electric Supply Co., South Canal street, Chicago, report their sales for the last month as exceedingly heavy, and the demand for their specialties particularly good.

Mr. A. S. Terry, of the Sunbeam Incandescent Lamp Co., Chamber of Commerce Building, Chicago, says business is good and the demand for Sunbeams fully up to his expectations.

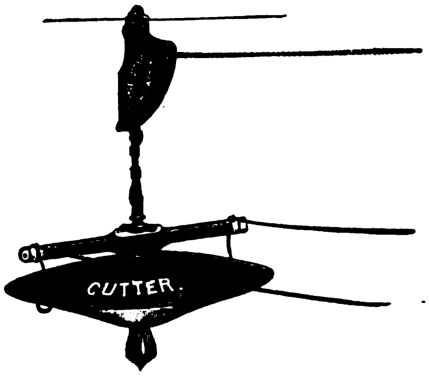
Mr. R. E. Gallaher, secretary of the New York Insulated Wire Co. spent a week or so recently in Chicago.

The Telegraphers' Mutual Benefit Association, at its annual meeting last week, reported a very successful year, and President Merrihew congratulated the members on the great good work done by the society during its 25 years of existence; $1,000 was appropriated to push the membership this year. The old officers were re-elected. In the evening the Magnetic Club gave a very successful dinner.

CUTTER'S SUSPENSION STREET HOOD.

Street lighting with incandescent lamps is getting to be quite a common practice in all parts of the country, and in many places the lamps are hung over the centre of the street. This plan is considered the best on shady streets where the foliage would cut off much of the light from a lamp placed at the corner. Then in order to get a proper distribution of the light it is necessary to have a specially designed reflector, which can be combined with the protecting hood. In many cases the hoods, hooks and pulleys used have been picked at random from the nearest stock, the result being a combination which neither looks neat nor is well adapted to the purpose.

After studying the needs in this line for some years, George Cutter has perfected the suspension street hood shown in the cut. It embodies a number of novel features. The hood is designed so as to protect the socket thoroughly from the weather, while a unique spring-catch and hinge allows it to be opened when desired. The nozzle which supports the socket is arched, so that it can be readily wired, and the tin parts are separable so that they can be nested for shipment. Another patented feature is the method of clamping the parts of the crossarm, whereby the hood itself is insulated from the suspending cable. The pulley used with this hood is known as "Cutter's Petite" and is a small size of the lamp-supporting pulley designed for arc lamp practice, holding the hood safely even if the hoisting rope should slip.



Cutter's Suspension Street Hood.

The same suspension outfit is also used by some plants on alternating circuits with the transformer hung just above the hood, and in all cases it makes a neat and very serviceable combination. George Cutter, of Chicago, is the patentee and sole maker.

A DESIRABLE AND PRAISEWORTHY APPOINTMENT.

Mr. J. E. Ham, who has for some years held the position of chief clerk, and, as well, for a portion of the time, managed the business of the New York office of the Kerite Co., has been appointed general agent with headquarters at New York, by Mr. W. R. Brixey, who has succeeded to the entire wire business of the late A. G. and S. A. Day, respectively. Mr. Ham is one of those young men who by strict attention to business and by sterling business qualities has reaped a portion of the reward commensurate therewith. The acquisition is a desirable one and the interests of that old, tried and trusted wire, Kerite, will be perfectly safe in the hands of the subject of this little note.

ELECTRICITY WASN'T IN IT THIS TIME.

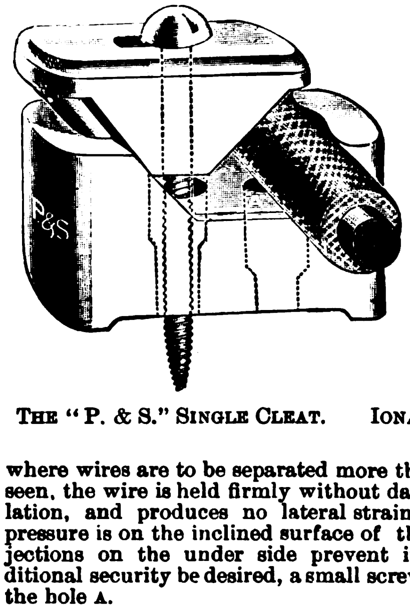
A very good story has been going the rounds lately in the city of Albany, N. Y. It seems that a short time after the celebrated Empire Express was put on between New York and Buffalo, three colored men employed in one of the large Hudson River brickyards had never seen the famous train pass, although they had heard a great deal about it, the reason being that in any position they had heretofore taken the train had passed and all the sight they had been able to get of it was a mere glimpse of the fluttering rear signal flags. Well, one day the three arranged to stand thus:—No. 1 at the north end of the yard; No. 2 at the south end and No. 3 in the middle, and as the train approached each would notify the other so as to secure a good look at the train as it sped by them. They had but a few seconds to wait. It came. The man at the south end called out: "Here she comes;" the one at the north end, "There she goes;" and the one in the middle "Gee! Whiz! Whar am she! aint she greased lightnun!" The Empire Express, is, indeed, fast enough to travel over the wires, and that is one of the reasons why it is so popular in electrical and business circles.

IONA HAND LIGHTING BURNER.

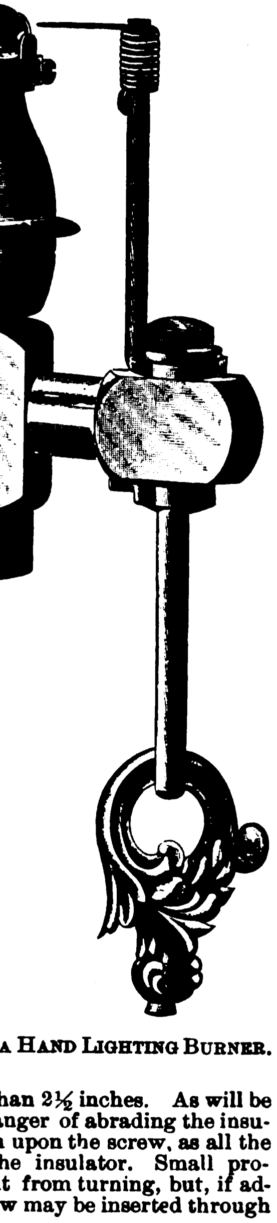
We illustrate below the Iona hand lighting burner, which is being placed on the market by the Redding Electric Co., 41 Federal street, Boston, Mass., and which, as will be readily seen from the cut, is entirely new in design and is simplicity itself. There are no cams or complicated springs to get out of order, and being operated only by the key, it is absolutely safe from leaking gas. This burner, like the Iona safety pendant mentioned in our last edition, is made in the most careful manner, the valves being hand ground and the stems made in various lengths to suit fixtures. From the orders already received by the Redding Co., these burners seem likely to have a very large sale.

THE "P. & S." SINGLE CLEAT.

Prominent among the latest novelties introduced by Messrs. Pass & Seymour, of Syracuse, N. Y., is the adjustable single cleat shown in the accompanying illustration, and designed for use where wires are to be separated more than 2½ inches. As will be seen, the wire is held firmly without danger of abrading the insulation, and produces no lateral strain upon the screw, as all the pressure is on the inclined surface of the insulator. Small projections on the under side prevent it from turning, but, if additional security be desired, a small screw may be inserted through the hole A.



The "P. & S." Single Cleat.



Iona Hand Lighting Burner.

This cleat, in common with the other specialties made by this company, is of their well known Syracuse china, thoroughly vitrified.

AN IMPORTANT LICENSE.

Queen & Co., of Philadelphia, have granted a license to George Cutter, of Chicago, to sell a new line of ammeters and voltmeters, which will be known as the "Cutler non-inductive instruments." These goods come under the Cardew patent, which is the property of the former concern, and covers instruments that make use of a heated wire.

NEW YORK NOTES.

Col. H. C. Adams, who has been the New York agent of the Fort Wayne Electric Company for some time past, has resigned that position, and will hereafter conduct the affairs of the Phillips Insulated Wire Company as its president. Its specialty is the weatherproof and damp-proof "O. K." line and house wires. Col. Adams is a very old and experienced hand at the wire business, which he goes back to with the added advantage of knowing the other side of the question. The Phillips Insulated Wire Company have a large factory at Pawtucket, and are already doing a very satisfactory trade. Col. Adams retires from 44 Broad street with many regrets on the part of his associates; and it is understood that he has received a very handsome acklowledgment of his past services from Mr. C. A. Coffin.

E. A. Gay respectfully announces that he has engaged in the general electrical specialty and supply business under the firm name of E. A. Gay & Co., with an office in the new Beckley Building, South Clinton street, Rochester, N. Y. He has the general agency for the Carpenter electric heating and cooking apparatus. Wire, cord, lamps, and other staple electric lighting supplies are carried in stock. The old partnership of Putnam, Gay & Co., is dissolved. J. E. Putnam and S. A. Ellis will continue under the firm name of J. E. Putnam & Co.

Mr. W. F. Richardson, who, by the way, is a member of the firm, the Enterprise Electric Co., of Chicago, has been making a flying trip through the East, in the interests of his company. Mr. Richardson honored this office with a call. Several large manufacturing concerns have been visited and some desirable connections made although his company has been organized but a few months. Trade has been better far than anticipated. Mr. Richardson left for the World's Fair city on Monday night.

The Genett Air Brake.—A cheering and at the same time unfortunate report comes from the New York office of the Genett Air Brake Company. The orders received by them since the street railway convention at Cleveland have "outclassed," as it were, their capacity. Moral—The many good points of this simple and yet postive acting brake were appreciated by the many interested ones who saw the mechanism in operation.

Electric Engineering and Supply Co., Syracuse, N. Y., have issued a very tasteful and effective folder in colors, calling attention to the fact that they have the order for the World's Fair detail supplies, and giving text of the order from the New York Insulated Wire Co. for the work. It is a neat piece of design and printing, and emphasizes a triumph that the Syracuse concern is justified in being jubilant over.

J. Jones & Son, 39 Vesey street, this city, report large sales of their contact protected bells. The agency in the West has now been taken by the Central Electric Co., of Chicago, who propose in the future to sell the contact protected bell only. This speaks well for the class and quality of this article, as the Central Co. is one af the largest users of these goods in the territory named.

Mr. William M. Sturges, 22 Main street, Utica, N. Y., has opened offices at the address named as a consulting electrical engineer, particularly in connection with electric railway work. He has had fifteen years' experience, and is familiar with questions of management, construction, etc. His fees for mechanical and electrical work are small.

PHILADELPHIA NOTES.

Warren Webster & Company, 491 North Third street, Philadelphia, Pa., patentees and manufacturers of the Webster Vacuum Feed Water Heater and Purifier, and licensees for the sale of patent rights of the Williames vacuum system of steam heating, report the following orders during the month of October: David Lupton Sons, Philadelphia, Pa.; Lord & Taylor, New York; Armour & Co., Chicago; Chicago Malleable Iron Works, Chicago; Boughen Engineering Company, Cincinnati, O.; Jas. McClurg & Co., Pittsburgh, Pa.; M. H. Crane, Cincinnati, O.; Lalance & Grosjean Manufacturing Company, Harrisburg, Pa.; Prahar & Bro., Brooklyn, N. Y.; Apollo Iron and Steel Company, Apollo, Pa.; Roaring Spring Blank Book Company, Roaring Spring, Pa.; Pennsylvania Railroad Company, Union Depot, Pittsburgh, Pa; Pennsylvania Steel Casting & Machine Company, Chester, Pa.; Remington Paper Company, Watertown, N. Y.; Armour & Co., Kansas City, Mo.; Botsford Paper Mill Company, Kalamazoo, Mich.; M. Price, Newark, N. J.; Risdon Iron and Locomotive Works, San Francisco, Cal.; Charles Kaestner & Co., Chicago, Ill.; Maryland Steel Company, Sparrow's Point, Md.; Commonwealth Hotel, Harrisburg, Pa.; Harrisburg Foundry and Machine Company, Harrisburg, Pa.; Crompton Company, Quidnick, R. I.; American Fire Engine Company, Seneca Falls, N. Y.; Royal Weaving Company, Pawtucket, R. I.; Pennsylvania Steel Company, Steelton, Pa., this order being for 8,250 h. p. They have just issued a new catalogue, and visit plants at their expense, and furnish apparatus upon trial under guarantee.

The Spreckels Sugar Refinery.—A notice has been going the rounds of the press of the increase in the Spreckels Sugar Refinery in Philadelphia, calling for the placing of five large engines. One of these is to drive an addition to their electric light plant, consisting of an 800-light toothed armature alternating dynamo and exciter for same, which will go in their present dynamo-room and be coupled in to the present system. This increase makes this isolated plant take rank as one of the largest in the country, the total capacity being over 3,000 lights, and the whole arranged as a central station; no fewer than 24 separate circuits being carried to different parts of the buildings. The original plant was installed several years ago by Messrs. M. R. Muckle, Jr. & Co., and it is notable that it has operated till the present time without costing a dollar for repairs, and for the greater part of this period has been run night and day. The contract for the new plant goes to the same firm. No gas piping whatever has been installed in the refinery, and it is interesting to note that the total cost of the original electric light plant including the dynamos, engines, convertors, wiring, etc.; in fact, all details except boilers, was no more than the bid for properly piping the entire refinery for gas. The bid for piping included, however, a six-inch main to be run for two squares in the street since there was no main immediately at the refinery of sufficient capacity to supply the amount of gas which it was calculated would be needed to light the works.

A Reception at Queen & Co.'s Laboratory, Ardmore.—At the invitation of Messrs. Queen & Co., a large party of gentlemen visited the laboratory of the company at Ardmore, a short distance from Philadelphia, last Saturday. Upon their arrival they were shown over the building and given the opportunity to inspect the methods employed by Queen & Co. in constructing and testing the large variety of electrical instruments manufactured by them. The visitors were afforded ample opportunity of judging of the variety of work by an excellently arranged exhibit of the Queen instruments, to which were added a number of foreign make. Among the latter was a Boys radio-micrometer, the first brought over to this country. The party were very handsomely entertained at luncheon. Mr. E. G. Willyoung, superintendent of the laboratory, deserves great credit for the success of this most entertaining and instructive affair, which was greatly enjoyed by all present.

The Philadelphia Engineering Works, manufacturers of the Philadelphia Corliss engine, have under construction over 40 engines, ranging in power from 50 to 500 h. p., among which are two 500 h. p. vertical cross-compound condensing engines for the Hudson Electric Light Co., of Hoboken, N. J. The plant is designed for four of these massive engines, two of which will not be shipped for several months. The fly-wheels will measure 17 feet in diameter, 54 inch face, and will weigh 45,000 pounds each. The speed will be 100 revolutions per minute. These engines are designed to operate an arc and incandescent plant and railway generators. The Philadelphia company are about to ship two large double compound condensing tandem engines, for the Springfield (Mass.) Armory; two tandem compound non-condensing engines, for the Omaha Grant Smelting Co., of Denver, Col., and two coupled high pressure engines, for the Watervliet Arsenal of West Troy, N. Y.

Messrs. M. R. Muckle, Jr., & Co. have lately finished the installation for the Weisbrod and Hess Brewing Company, of a 350-light dynamo and 35 h. p. Westinghouse Standard engine. The lights displace all other kinds of illumination throughout the brewery and have proved themselves of especial value in the beer cellars. A feature of the installation is the use in several places of 150 c. p. lamps in preference to groups of lamps of smaller candle power. This week there is a large trade display on the street which runs past this brewery, and a handsome arch has been erected, on which a large amount of decoration has been done with incandescent lamps to be operated from the brewery dynamo. This work is of course only temporary but has a very fine effect.

Mr. C. S. Clunn, a well-known mechanical and electrical engineer, has opened offices at the Scott Building, 1217 Filbert street, where he will act as agent for the Hoover, Owens & Rentschler Company, builders of the Hamilton-Corliss Engine and the Valley Iron Works, of Williamsport, Pa. Mr. Clunn is prepared to install complete steam and electric light plants, including construction work, and has contracts for several which are now under way.

The Fort Wayne Electric Co., through their agent, Mr. G. A. Wilbur, have sold an additional 75 Wood arc light machine to the Millville (N. J.) Electric Light Co., and 60 Wood double arc lamps of the new clutch style to the Powellton Electric Co.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

VOL. XIV. NOVEMBER 30, 1892. No. 239.

THE LIGHTING OF WASHINGTON PARK, CHICAGO, ILL.

BY

Fred A. Schaffler

WASHINGTON PARK is located in the south-eastern part of the territory now included and known as Chicago proper, and is one of the many parks controlled exclusively by the Board of Commissioners of South Parks and Boulevards. The lighting of Washington park and adjoining Boulevards was formerly accomplished by the ordinary gas lamp-post system. The entire park and the four principal Boulevards are now illuminated by the most comprehensive system of park underground installation ever undertaken by any city in the West, if not in the United States.

The electric companies throughout the country fully realized the value of the opportunity to equip such a plant, and much sharp competition was the result of the commissioners' advertisement for bids for the work which occurred in February last. The specifications were unusually exacting in all details, especially that of insulation of the dynamos in multiple and single, and in the line and underground construction.

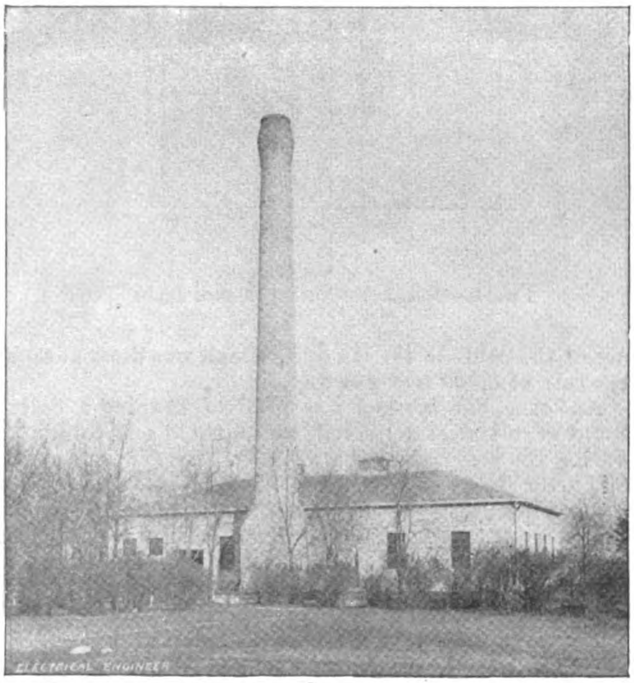


FIG. 1.—ELECTRIC LIGHT STATION, WASHINGTON PARK, CHICAGO.

The contract for the entire plant was awarded to the Brush Electric Company, from among five competitors, and they sublet it as follows: The steam plant to Messrs. Fraser & Chalmers, of Chicago, who furnished their new type of high speed Corliss engines and Campbell & Zell safety water tube boiler. The underground cables were sublet to the Safety Insulated Wire Company, and the tubing work was given to Thomas Jackson & Son, who did the work under the direct supervision of the Brush Electric Company's representative.

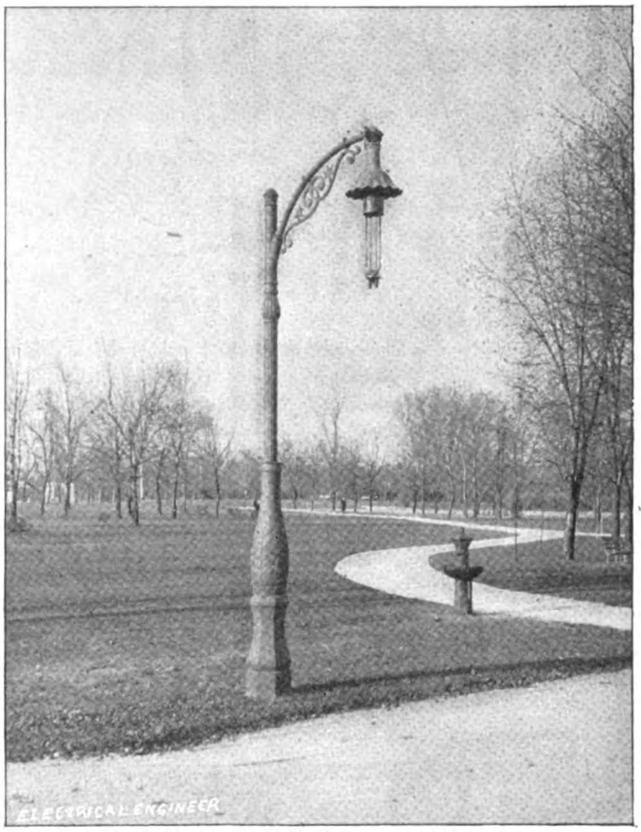


FIG. 2.—ORNAMENTAL LAMP POST, WASHINGTON PARK, CHICAGO.

The station plant Fig. 6, consists of three 10 x 14½ x 24-inch non-condensing compound engines, each of 110 h. p., running at 140 revolutions per minute, belted direct from six 10-inch pulleys to six Brush dynamos, each having a capacity of 50 lamps of 2,000 c. p. each. The belt speed is 4,350 feet per minute. The engines have capacity to operate three extra dynamos of the same size, when such increase of plant is deemed necessary. The station is fully equipped with all electrical apparatus of the latest type, and is also furnished with a switch-board of proper design to accommodate eight dynamos and eight circuits, and arranged to quickly transfer any dynamo on any circuit with specially devised safety cables and plugs. This switch-board is also fitted with an exceedingly ingenious ground detector for locating grounds, at the station, any circuit. Steam is supplied by the water tube boilers at a pressure of 120 pounds per square inch. The commissioners built a very substantial power house to accommodate the plant, according to the designs of their engineer, Mr. Charles Livings. All the installation has been, on behalf of the commissioners, under the direct supervision of Mr. J. Frank Foster, general superintendent of South Parks.

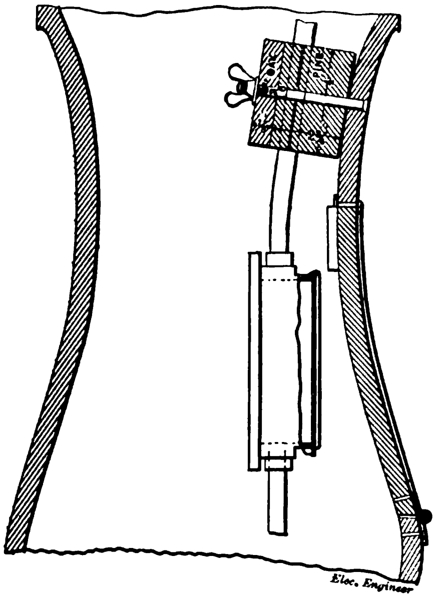


FIG. 3.—CUT-OUT SWITCH IN LAMP POST.

The outside work consists of 29¼ miles of cables laid underground in a conduit made of 1½-inch and 2-inch steel pipe, standard gauge, with screwed couplings, and is laid from 14 inches deep in lawns to 5½ inches deep under cable railway crossings. The underground cable consists of No. 5 solid B. & S. gauge copper wire covered with $\frac{3}{16}$-inch rubber insulation, one wrapping of tape outside of this, and the whole covered with a lead casing $\frac{3}{16}$-inch thick. The specifications called for this cable to have an insulation resistance of 100 megohms per mile when disconnected, and the system to have an insulation resistance of one megohm when connected with lamps and dynamos in running order.

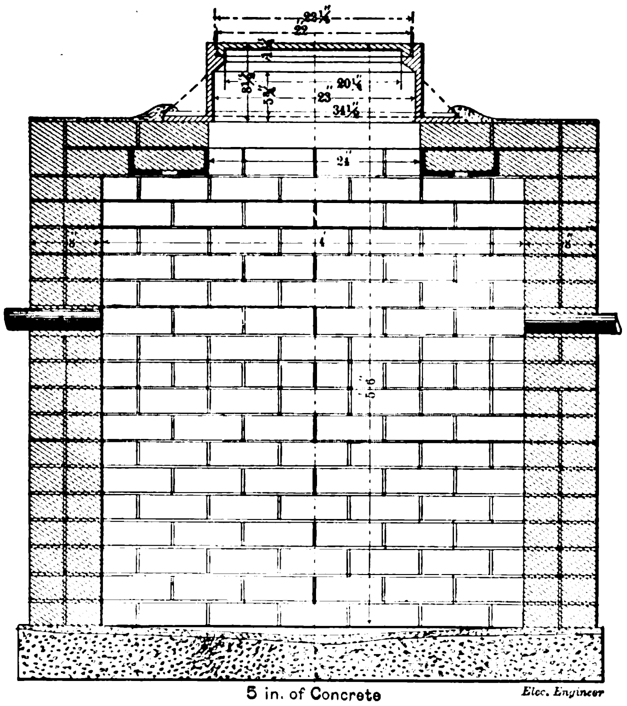


FIG. 4.—MANHOLE, WASHINGTON PARK, CHICAGO.

The conduit throughout the system is furnished with 30 deep manholes and 340 handholes at proper locations, the manholes being placed where there are more than two cables in the conduit. These manholes, Fig. 4, are made in circular form, of hard brick, and are thoroughly water tight in construction, the roof and cover being supported by heavy T irons. The handholes are cast iron receptacles of ample size, furnished with self-locking covers, also of cast iron.

Considering the fact that the ground was not broken until August 1, and the entire underground work, including the foundations for the lamp-posts, was completed by September 27, much credit is due to the persons immediately in charge of the work for the rapid completion of the undertaking. A little calculation will show that, deducting Sundays and days on which the weather interfered, the actual number of working days was forty-six, and that the average amount of conduit laid per day was 2,152 feet. On several occasions 6,000 feet was laid per day of ten hours. The above, of course, does not include the laying or drawing of the cable in the conduit, which was done at an average rate of 5,000 feet per day.

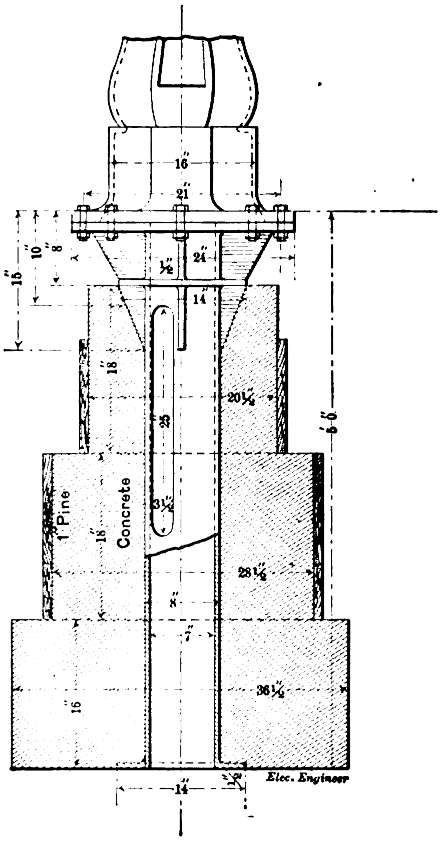


FIG. 5.—BRICK FOUNDATION FOR LAMP POST.

An excellent method was used of keeping a daily account of material delivered, conduit laid and cable drawn, during the progress of the work. It is very interesting to look over these daily records as the work progressed—or did not progress—as they show specifically just what the causes for delay were—sometimes on the conduit blanks, non-delivery of sufficient material, stones and rocks, cable railway or a network of piping, or other causes.

There are 260 lamp-posts of special design, approved by the commissioners. Each post is of cast iron, and is supported on a substantial brick foundation, shown in section in Fig. 5. The general design of the post complete may be seen in the view, Fig. 2, which shows the lamp located in front of the Park casino. The post carries a hood also specially designed and approved, the whole harmonizing well with the surroundings. The lamps are hung somewhat lower than is the usual custom for this class of illumination, principally on account of there being many placed under trees in the Park; but they are distributed generously, so that the effect is an excellent general illumination. Each post is also furnished at the base with an independent switch for cutting out the lamp and short circuiting it, access to which can only be obtained by opening with suitable key a door in front of the switch. The latter, as shown in Fig. 3, is mounted on a hard rubber base $\frac{1}{2}$ inch thick, and is encased in a cast iron box fitted with a sliding glass cover. The hood is furnished with the usual hanger board and cut-out switch. There was used in wiring the lamp-posts two miles of No. 5 B. & S. flexible cable, covered with $\frac{3}{16}$-inch rubber, taped and braided.

The plant was started in operation for the first time on October 20, on Park circuits, just in time to assist materially in the ceremonies connected with the dedication of the World's Fair. The entire installation was in operation November 1. The type of lamp in use on this system is the now well-known Brush-Adams No. 31, 2,000 c. p. double arc lamp.

The whole system, as installed and operated, is unquestionably a model one for use in large cities where such parks and boulevards or streets should be as well illuminated as practical and scientific methods, and the finances of the city, will permit, whether the city owns the plant or purchases the illumination from a lighting company.

To Mr. Alex. Dow, engineer of the Chicago district of the Brush Electric Company, should be given the credit of pushing the work forward, in a careful and systematic manner, as the work on behalf of the Brush Electric Company has been under his direct supervision.

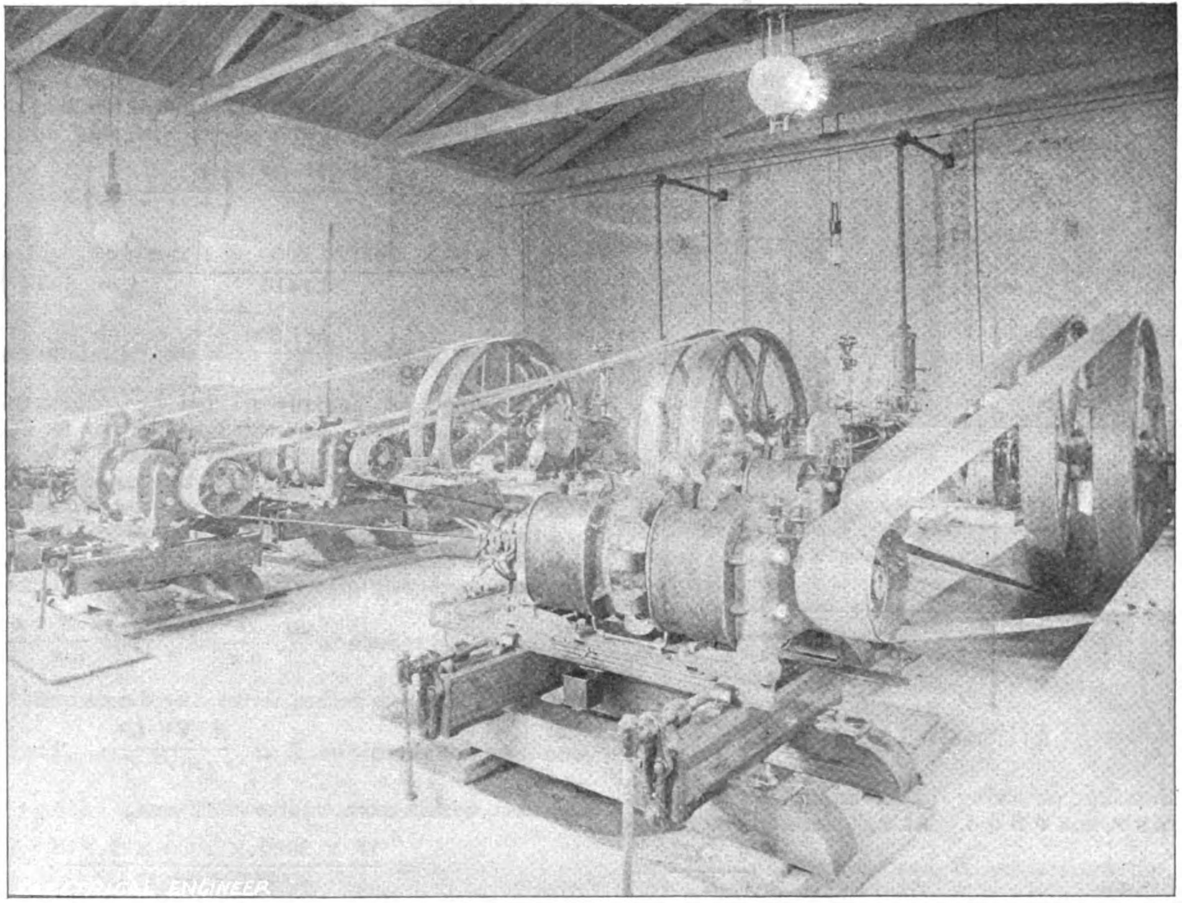


FIG. 6.—ELECTRIC LIGHT PLANT, WASHINGTON PARK, CHICAGO, ILL.

THEORETICAL ELEMENTS OF ELECTRODYNAMIC MACHINERY.[1]—XIII.

BY

A. E. Kennelly

ALTHOUGH the distribution of stress in a magnetic circuit may always be found by summing the vector products of flux and current on each element of conductor, it is sometimes more readily obtained by determining the local values of $\frac{B^2}{8\pi}$ throughout the system, and from these their resultants.

As an example of some practical importance, we may consider a closed hollow ring or circular solenoid with a uniform winding of N turns, a square cross section of A sq. cms. $= b^2$, and generating radii of r and R cms. as represented in plan and diametral section by Fig. 33. By preceding results, we know that when excited by a current of C units, the intensity B within the core at any radius ρ is $\frac{2\,N\,C.}{\rho}$ The flux paths are all circles and exert a tension of $\frac{B^2}{8\pi}$ dynes per sq. cm. along these circles, but which tensions are nowhere directly impressed upon the walls of the ring. If the intensity within the ring were uniform, the total tension exerted across any section

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[1] Copyright 1892, by A. E. Kennelly.

PR of the hollow core would be $\frac{A\,B^2}{8\pi}$, but since the intensity diminishes outwardly, the total tension must be found by subdivision of the area into elements and summing the elementary tensions on each. In this instance the surface integral of the tension $T = \int_r^R \frac{B^2}{8\pi}\,dA$, where

$$B^2 = \frac{4\,N^2\,C^2}{\rho^2} \text{ and } dA \text{ becomes } b.\,d\rho, \text{ so that}$$

$$T = \frac{4\,N^2\,C^2\,b}{8\pi}\int_r^R \frac{d\rho}{\rho^2} = \frac{N^2\,C^2\,b}{2\pi}\left(\frac{1}{r} - \frac{1}{R}\right) \text{dynes},$$

and this is the stress exerted across any radial sections such as P R and S Q when the thickness of the conductor wound on the ring need not be considered.

The stress that is directly brought to bear upon the walls of the core consists of the side thrust or outward pressure of $\frac{B^2}{8\pi}$ dynes per sq. cm. The stress on the plane surfaces D E F G, and H J K L being equal, opposite, and equilibrating through the substance of the walls, may be omitted from consideration, reserving for examination the curved surfaces R E S F, and P D Q G. At any point on the former and outer circumference, *B* has the value $\frac{2\,N\,C}{R}$ and the pressure is $\frac{1}{8\pi} \times \frac{4\,N^2\,C^2}{R^2}$ dynes per sq. cm. radially outwards. At any point on the inner surface, *B* is $\frac{2\,N\,C}{r}$ and the pressure is $\frac{1}{8\pi} \times \frac{4\,N^2\,C^2}{r^2}$ dynes per sq. cm. directed towards the center O. Two symmetrical systems of stress are thus established, one resident at the outer circumference and directed radially outwards, the other resident at the inner circumference and directed radially inwards.

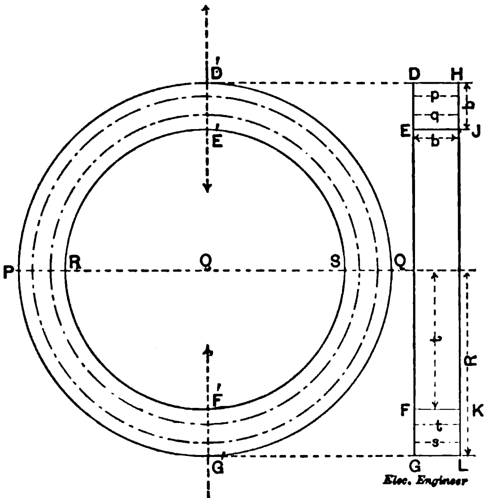

Fig. 33.

Selecting any diameter, such as P O Q, the resultants of the first system directed across this plane are stresses $\frac{b\,N^2\,C^2}{\pi R}$ dynes along O D', and O G', while the resultants of the second system are two equal stresses of $\frac{b\,N^2\,C^2}{\pi r}$ dynes along E' O, and F' O, respectively. These forces do not equate but leave a balance directed inwards of $\frac{b\,N^2\,C^2}{\pi}\left(\frac{1}{r} - \frac{1}{R}\right)$ dynes along E' O, and F' O. This will be the stress which, if the ring were actually divided by the plane P O Q, the two halves would mutually exert upon each other, or the magnetic attraction which they would evince. Its amount would be equally shared between the two sections P R, and S Q by symmetry, and each section would support a stress of $\frac{b\,N^2\,C^2}{2\pi}\left(\frac{1}{r} - \frac{1}{R}\right)$

The stress exerted tangentially through the walls of the solenoid may be ascribed to the resultant side thrust from the flux and is here equal to the total tension exerted by the flux within the interior. This proposition has very general applications, for in any active coil it is evident that equilibrium could not exist across any section of the coil, unless the stress supported by the substance of the walls counterbalanced the total tension of the flux, and the resultant tension is generally more readily determined than the resultant pressures that equate it.

As a numerical illustration of the foregoing case presented in Fig. 33, let $r = 10$, $R = 14$, $b = 4$, $N = 2000$, $C = 2$ (absolute units) or 20 amperes. Then the total force exerted across any diameter of the ring would be

$$T = \frac{b\,N^2\,C^2}{\pi}\left(\frac{1}{r} - \frac{1}{R}\right)$$

$$= \frac{4 \times 2000 \times 2000 \times 2 \times 2}{3.1416}\left(\frac{1}{10} - \frac{1}{14}\right)$$

$$= 581{,}900 \text{ dynes} = \frac{581{,}900}{981} = 593.2 \text{ grammes weight.}$$

If the ring were actually divided by a diametral plane P O Q the upper half, suspended at its centre E^1, would support the lower half vertically beneath it by magnetic force under these conditions, if the mass of that lower half did not exceed 593 grammes, each section, P R and S Q exerting a total stress of 296.5 grammes weight.

If the difference of intensity over the cross-section of the ring were negligible, the tension exerted across any section would reduce to $A.\,\frac{B^2}{8\pi}$ simply, or $\frac{A}{8\pi} \cdot \frac{4\,N^2\,C^2}{r^2}$ and the total stress acting across any diameter of the ring would be double this or $T = \frac{A\,N^2\,C^2}{\pi\,r^2}\cdot$ Thus in the last case, with a mean radius of 12 cms.,

$$T = \frac{16 \times 2000 \times 2000 \times 2 \times 2}{3.1416 \times 12 \times 12}$$

$$= 565{,}800 \text{ dynes} = 576.8 \text{ grammes weight.}$$

The tension across each section being 283.4 grammes weight and by the adoption of the approximate formula, the stresses would have been here underestimated by about three per cent.

The formulæ indicate that the tensions exerted across a section of any closed circular solenoid without iron, are proportional to $(N\,C)^2$ or the square of the current turns. This is a direct consequence of the facts that *B* is proportional to the current turns, and the tension in its turn is proportional to B^2.

We may next consider the distribution of stress within a double solenoid or pair of concentric rings, one of which is enclosed within the other. Such a system is related to the practical case of a solenoid with more than one layer in its winding. In Fig. 33, the dotted lines through *p q s* and *t* represent the walls of an internal concentric ring of radii r_1 and R_1, current C_1 and N_1 turns. All the walls of the double solenoid may be supposed rigid, but of negligible thickness.

Exciting the outer coil only, the intensity at any point within it of radius ρ will be $B_0 = \frac{2\,N\,C}{\rho}$. Exciting the inner coil only, the intensity will be $B_1 = \frac{2\,N_1\,C_1}{\rho}$ at any point within its walls, but zero beyond them. Exciting both coils simultaneously, the intensity at any point in the internal ring will be that due to both coils, or

$$B_0 + B_1 = \frac{2}{\rho}\,(N\,C + N_1\,C_1.)$$

For a point within the outer ring but without the inner, $B_0 = \frac{2\,N\,C}{\rho}$ remains undisturbed.

The stress per sq. cm. under these conditions will be $\frac{(B_0+B_1)^2}{8\pi}$ within the inner ring, and $\frac{B_0{}^2}{8\pi}$ within the outer only. Across any section such as S Q, the surface integral of tension over the inner ring will be

$$t_1 = \frac{b\,(N^2\,C^2 + 2\,N\,N_1\,C\,C_1 + N_1{}^2\,C_1{}^2)}{2\,\pi}\left(\frac{1}{r_1} - \frac{1}{R_1}\right)$$

Similarly between radii r and r_1 of the outer ring the total tension will be $t_2 = \frac{b\,N^2\,C^2}{2\,\pi}\left(\frac{1}{r} - \frac{1}{r_1}\right)$ and again between radii R_1 and R, $t_3 = \frac{b\,N^2\,C^2}{2\,\pi}\left(\frac{1}{R_1} - \frac{1}{R}\right)$. The total tension across the entire section must be $T = t_1 + t_2 + t_3$.

It might, at first sight, be supposed that since the total tension within the inner ring is t_1, its walls must sustain a stress of this amount. If, however, the side thrust pressures due to the intensities adjacent to the walls, be summed and compounded, it will be found that the stress on those of the inner ring will only be

$$\frac{b\,(N_1{}^2\,C_1{}^2 + 2\,N\,N_1\,C\,C_1)}{2\,\pi}\left(\frac{1}{r_1} - \frac{1}{R_1}\right),$$

while the balance of t_1, or $\frac{b\,N^2\,C^2}{2\,\pi}\left(\frac{1}{r_1} - \frac{1}{R_1}\right)$ is supported by the stress from the external intensity B_0, and is carried over to the outer coil. The stress supported by the walls of the outer ring is thus increased to

$$\frac{b\,N^2\,C^2}{2\,\pi}\left\{\left(\frac{1}{r} - \frac{1}{r_1}\right) + \left(\frac{1}{r_1} - \frac{1}{R_1}\right) + \left(\frac{1}{R_1} - \frac{1}{R}\right)\right\}$$

across any section, or simply $\frac{b\,N^2\,C^2}{2\,\pi}\left(\frac{1}{r} - \frac{1}{R}\right)$; and this would be the stress on those walls if the inner ring were absent or remained unexcited.

In a compound circular solenoid, therefore, the total stress sustained by all the walls together is equal to the surface integral of tension over the whole area to the limits enclosed by the outermost, but its distribution among the rings is such, that the inside coils take less than the integral tensions over their own sections, leaving the balance to the walls outside. This tends to secure a more uniform distribution of the total tension on the walls. The outside layer always carries the stress that it would support if all the inner rings were removed or left unexcited.

The introduction of iron into the magnetic circuit produces no change in stress principle, but usually a great change in its degree. If the magnetized iron be regarded as the equivalent of a certain solenoid, or combination of solenoids, the magnetic stresses that would be developed in that equivalent solenoid, are developed in the iron. While, however, we have seen that equilibrium of stress exists throughout the hollow core of a simple coil or solenoid, and that stress is only manifested in the walls, or turns of active conductor, the stress in iron is developed throughout its substance. A uniformly magnetized bar of iron when divided across by any plane exhibits attractive force between the severed portions all over their opposed areas, just as its equivalent solenoid would do, if the insulated wire was spirally wound in a groove on a core of copper or silver, so rigidly that the stresses exerted by the wire became imparted to the encircled substance. Apart from the artificiality of the hypothesis by which an equivalent solenoid is substituted for a magnet, this distribution of the stress through the substance of the iron must follow from the molecular nature of magnetization demanding in strictness a correspondingly large number of molecularly small solenoids to adequately represent the theory, whereas, for practical magnetic purposes a single solenoid representing the entire mass might give sufficient approximation.

INCREASED COMMERCIAL EFFICIENCY AND HIGHER ECONOMY IN CENTRAL STATIONS.—III.

BY

J. H. Vail

CONDENSERS.

The expert engineer is, of course, familiar with the value of each type of condenser, but a brief explanation of the different types, the requisite conditions for their use, and the saving to be derived may be of interest to central station managers.

Under favorable conditions, we may expect a marked saving in coal by the application of the condenser. This saving should be from 20 to 25 per cent. and yet it is possible that by employing a condenser wasteful of steam or with engine and exhaust pipes in leaking condition, the condenser may cause a positive loss. Condensers should preferably be used with compound or triple expansion engines.

One of the essential conditions is an ample supply of cold water. Another important point is that the system of exhaust piping shall be absolutely air tight. Special attention must be given to the pipe joints, piston and valve rod packing, and all leaks should be stopped, no matter how minute. The writer has seen an increase of several inches in vacuum by simply hunting out and stopping small air leaks.

The economy to be secured by the condenser is due to the vacuum formed on the exhaust side of the engine piston and the consequent removal of atmospheric pressure therefrom as well as back-pressure in exhaust passages and pipes. The application of the condenser removes the back pressure and forms a constant vacuum equal to from 12 to 14 pounds per square inch on the exhaust side of the piston; the steam can consequently be expanded to nearly absolute zero pressure, thereby obtaining its full expansive power.

We will briefly review the condensers under two divisions or types, viz., Surface Condensers and Jet Condensers. As to the leading conditions under which one or the other type of condenser should be applied, I will assume that the cost of feed water is the essential point on which the decision should usually be made. There may be other conditions which are of minor importance, but we will leave them for future attention.

Surface Condensers.—The surface condenser with its appurtenances, *saves* the condensed steam which is delivered to the hot well and the water may be used over continually for boiler feed, the waste of feed water being very small. The circulating water being separate from the condensed steam, it may be salty or otherwise unfit for boiler feed; its principal requisite is low temperature. The surface condenser should be used where feed water is expensive and where water for condensation is not sufficiently good to be combined with the feed water and returned to the boilers. Therefore, its economy in saving feed water is a matter that should not be overlooked, as the feed water saved may soon more than repay the extra cost of surface condensers. As an illustration, in the Cincinnati Edison Station, condensing water (unsuitable for boiler feed) is obtained from artesian wells; with 600 h.p. average daily service, the total cost of water from city mains is about $4 50 per month, the same feed water doing constant service with but slight addition of supply from city mains.

The jet condenser, when applied in the customary manner, does not save the feed water. In original cost and in the cost of maintenance, the surface condenser is more expensive than the jet condenser. For a given horse power station capacity, the surface condenser and its necessary appurtenances, hot well, etc., will cost fully twice as much as the jet condenser.

A point of advantage that may be placed to the credit of the surface condenser with its air and circulating pump, is, that it can be started independently of the engine, thus forming a partial vacuum in advance of starting the engine. The grease taken up by the steam during its work in the cylinders is partially retained and held in suspension in the condensed water; this grease must be thoroughly extracted so as to avoid injury to boilers.

The Jet Condenser.—With the independent air pump and jet condenser, the exhaust steam from the engine is admitted into the top of the condenser and on its descent is met by a fine spray of cold water; the complete mechanical mixture of steam and induction water is thus obtained. The water deprives the steam of nearly all its latent heat, condenses it, and a vacuum is formed. With the jet condenser, it is understood that the feed water is united with the water of condensation and discharged. If, however, the condensing water is suitable for boiler feed, then an efficient form of grease extractor should be inserted in the exhaust pipes between engines and condenser, and the discharge from jet condenser can be run to a hot well and from there used as boiler feed; in this case the original feed water is saved, as with the surface condenser, but the feed water will be several degrees lower in temperature than from the hot well of surface condensers.

When a feed water heater is already located, if air tight, it need not be laid aside, as the same will partially act as a surface condenser between the engine and the independent condenser, the interposed heater increasing the temperature of the feed water, probably to about 150° F. Great care must be taken to insure against air leakage through heater shell and connections.

Therefore, we may say that when feed water is costly, use the surface condenser which saves it, and when feed water is cheap enough to be thrown away, use the jet condenser. The latter will apply when the condensing water is salty or unfit for boiler feed. Also by comparing the annual cost of water for boiler feed with the difference in cost between the surface or jet condenser, and the interest on the same, we can readily determine which type to apply.

The quantity of condensing water required depends upon its capacity for cooling, the lower the temperature the less water necessary. In this latitude, the water required will be from 20 to 25 times the amount required for boiler feed. There will be found certain stations of medium capacity where there is not obtainable a 24-hour supply of condensing water. Such a station might with profit be arranged so as to run a simple high pressure engine for all hours of light load, storing in reserve the water supply to be used with condensing engines during the few hours of heavy load. This type of combination station cannot fail to show good results.

INSULATED ELECTRIC CONDUCTORS.[1]—XIV.

BY

James Bowstead Williams M.E.

REMARK 3. Any remarks upon the third statement are almost superfluous, for it is evident that if lead or any other metallic conducting substance is present in a layer of paint, the I. R. of such layer is necessarily diminished in proportion to the amount of conducting material it contains. Lead compounds may be used in fireproofing paints, however.

Remark 4. No volatile liquid should be used as the *only* solvent for paint. If used at all, there should always be a non-volatile fluid, such as oil, used with it, so that the paint, when dry, may be tough and flexible. Unless oil or *its equivalent* is used, and in suitable proportions, the hardened paint is apt to soon become brittle, and also detached from the fibre.

Remark 7. Statement 7 can best be explained by a practical example. Take a wire covered with one thick braid, and saturate the braid with a paint containing a considerable amount of any volatile solvent. As soon as the paint is exposed to the atmosphere the outermost portion of the layer of paint dries first of all, and this hardened surface will then act as a barrier to the free exit of the volatile solvent in the paint beneath it, and the body of the paint will remain in a liquid state for some time. When the solvent does finally evaporate the paint will be found to contain numerous small air spaces which cause the entire covering of the wire to act somewhat like a sponge in absorbing moisture. Furthermore, this irregular drying of such a paint will also prevent paint subsequently applied from passing into and filling the spaces left after the first application unless a vacuum be used. Therefore, but one application of paint should be made to form a dielectric or layer thereof; and the proportion of solvent to solids should be such that the entire body of paint will either of itself harden uniformly or can be made to do so, and that few or no air spaces may be left in the covering. No rules can be given for this proportion, and experiment alone can determine it. In other words, every separate combination of solids will require a certain amount of solvent, and this amount can be ascertained only by preparing several specimens of the paint, saturating fibre on wires with them, and then selecting the best.

Remark 8. Driers may be used in some cases to accelerate the drying of oil in paints. But such driers should contain no lead or zinc salts when used, although they may have been prepared by the aid of such salts. The best driers are those containing a large proportion of shellac. Driers, although they facilitate the change of oil from a liquid to a flexible solid form, when the oil is exposed to the air, also cause the oil to change to a brittle resinous mass sooner than if the driers were omitted.

Remark 10. A good test of a paint is that it will not change in color or consistence, nor deposit *any* of its ingredients, after standing for several days, or even weeks. Nor must any of its ingredients separate during the drying of the paint. All of the ingredients must be freely soluble in the solvent or solvents used. Many paints which are apparently chemical solutions when fabricated will deposit some of their principal ingredients after standing for three or four days. The writer found this to occur more frequently when the hard resins, amber, copal, and shellac form a principal ingredient of paints.

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[1] *Copyright, 1892, by J. B. Williams.*

Remark 11. The writer has never yet been able to find a composition or combination of ingredients which could be combined and applied by means of water but what would dissolve in water after it had hardened either in air or by the aid of heat. Again, many commercial liquids which could be used as solvents contain water when purchased. This is especially the case with oil of turpentine.

A BIOGRAPHICAL SKETCH OF THE KHOTINSKY ACCUMULATOR.—VIII.—(*Concluded.*)

BY

Capt. A. de Khotinsky

THE reasons which have led up to the construction of the present form of my accumulator have already been given, and it now only remains to show in what manner this construction has been carried out in practice. The engraving, Fig. 36, shows one section enlarged, of the plates shown in Fig. 37. The latter shows two plates built up of five horizontal strips laid one above the other, as seen in the engraving Fig. 38, which shows the plates assembled ready to be placed in the containing jar. The horizontal strips are placed together at certain distances from each other, and the lugs cast in the lead frame surrounding the plates, serve to support the cell upon glass plates, which raise the bottom of the elements a short distance above the bottom of the jar. This permits free circulation of the electrolyte, as well as avoids the danger of short circuiting from any material which might accidentally fall to the bottom. The engraving, Fig. 39, finally shows the cell as built ready for use.

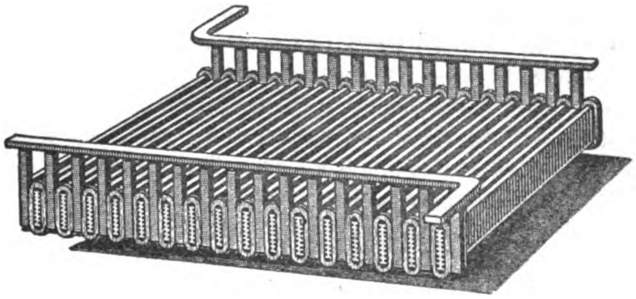


FIG. 36.

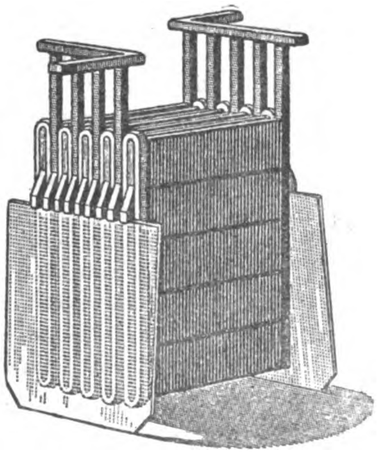


FIG. 38.

From the record of my work here concluded, it will be evident that the experiences which I have passed through have enabled me to learn what to avoid in the construction and operation of storage batteries. I confidently believe that the type of cell which is the result of all these experiences fulfills all the demands which the most exacting practice can call for.

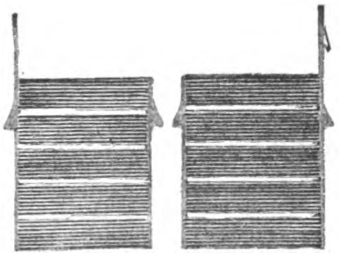


FIG. 37.

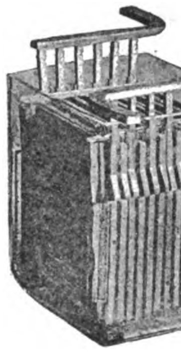
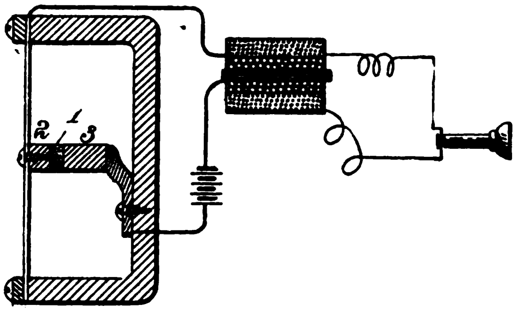


FIG. 39.

THE CLAMOND MICROPHONE.

A NOVEL method of overcoming the difficulties due to imperfect variation of resistance in telephone transmitters has recently been devised by Mr. Charles Clamond, of Paris, in which the resistance employed consists of a plastic body placed between the electrodes and lending itself readily to their vibrations; becoming long and thin, or short and thick, as the electrodes recede from, or approach, each other. The accompanying illustration shows a vertical section of the device included in the working circuit of a transmitter. The diaphragm has secured to its case the electrode (2), while a second electrode (3) is supported by a bracket fastened to the casing as shown. Between these, and adhering to each, is the plastic resistance (1), surrounded by a very thin casing of elastic, non-conducting material.



CLAMOND MICROPHONE.

The working resistance is made by mixing metallic or other conducting powders with viscid, non-conducting liquids or plastic substances, such as glycerine or vaseline, and the casing is made by coating the resistance with collodion or some similar substance.

ELECTRIC TRACTION IN BROOKLYN.

THE cars have been steadily arriving for the Atlantic Avenue Road in Brooklyn, from the St. Louis Car Company, St. Louis, Mo., equipped with Westinghouse motors on Peckham trucks. The road will be started as soon as the power-station is completed, which will take about two months.

The foundations are nearly ready for the building that will contain the power plant for the Eastern district of the Brooklyn City Electric Railroad. This power station will have a capacity of 12,000 h. p. The building is located at the foot of Division avenue on the river front.

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. XIV. NEW YORK. NOVEMBER 30, 1892. No. 239.

Scientific knowledge makes the great man greater, adding to his powers, while it guards the weaker brethren from many follies.—Fleeming Jenkin.

THE COST OF ELECTRIC SUPPLY.

HOWEVER great an engineering enterprise may be and whatever credit it may reflect upon its projectors and those who carry it out to completion, the fact remains that there are very few such undertakings which can be for one moment considered, independent of the question, Does it pay? We might go further even, and say that, as a rule, the engineering enterprise that does not pay, whatever benefits may accrue to those directly influenced by it, is a drawback to the development of the profession, in that a bad investment must shake the courage and confidence of capitalists, by whom such enterprises must of necessity be carried through. Electrical distribution as an engineering enterprise is no exception to this rule, but the designer of a station has now sufficient data at hand to so plan the details of construction and operation that he may be able to tell, with a tolerable degree of certainty, just what revenue can be expected from a station of given size in any particular locality. As an example of a method of predetermination of the probable cost of supplying electricity, we may call attention to the recent presidential address by Dr. John Hopkinson, F. R. S., delivered before the Junior Engineering Society in London.

Dr. Hopkinson starts by stating broadly that to attain the best results, a scientific engineer ought to have in charge the working out of the plans. In analyzing the elements which confront the engineer in a design of this nature, it is shown that the expenses of an engineering undertaking may be broadly divided into two classes. Thus, we have, first, the expenses which are quite independent of the extent to which the undertaking is used, and again, expenses which are absent unless the undertaking is used, and which increase in proportion to the use. Again, in some undertakings the service which the undertaking is designed to render can be performed at a time selected by the owners; in others, at a time selected by him to whom the service is rendered.

In the application of these principles to the supply of electricity for lighting, Dr. Hopkinson has chosen an imaginary station designed to supply 40,000 16-candle lamps; first, on the hypothesis that it shall always be ready to supply the 40,000 lights at half an hour's notice, day or night, but that the lights are hardly ever required; secondly, on the hypothesis that the 40,000 lights are steadily and continuously supplied, day and night. These, of course, are the two extreme cases possible. In the former the load factor is nil, while in the latter it is 100 per cent. If the charge is by meter at 8 pence per kilowatt hour, in the former case the revenue will be nil, and in the latter case it will be £730,000 a year.

Dr. Hopkinson then divides the cost of supplying electricity into two parts—a charge which is independent of the hours the supply is used, and a charge which is directly proportional thereto, and estimates each amount accordingly. To provide the maximum of 40,000 lamps requires an estimated outlay of £145,000. The fixed charges, including interest, taxes, depreciation, etc., would amount to £16,410 running light, and to £18,750 fully loaded. Coming to the most important item, the coal account, and adding it to the previous items, we get at the charges for running light, and fully loaded, viz.: £28,010 and £59,250 respectively. Thus, as Dr. Hopkinson shows, the cost of being *ready to supply* current for 40,000 lights at any moment throughout the year would be £28,010, whereas the cost of *actually supplying* the amount of current required for every minute in the year would be £59,250.

Based upon these figures, Dr. Hopkinson points out what he had already urged on the Board of Trade committee in 1883, viz., that a differential charge ought to be made to consumers, giving the benefit to those who used current during light load hours, and thus affording a revenue during hours of comparatively high running expense to the central station. Dr. Hopkinson has also prepared a chart comparing the charges at a fixed rate per kilowatt hour, and what he terms a "compound" rate which involves a certain fixed charge whether the current be used or not, and an added light charge for the amount of current actually consumed. This chart shows that for anything over 500 kilowatt hours, the compound charge is more economical to the consumer than the simple flat rate, and this gain in his favor increases rapidly with the increased use of the current. The curve also shows the enormously decreased cost of production with a heavily loaded station as compared with a lightly loaded one. In this connection, it may be pointed out that many American central stations might be said to charge a compound rate in that they have increased rebates with increased use of current by consumers, by which practically the same end is reached.

Thus far Dr. Hopkinson's calculations assume that the supply of electricity is carried on without the aid of accumulators. In view of the neglect of these adjuncts to central stations in this country, it is of special interest to follow his calculations regarding them. In order to show first the difference in the nature of storing electrical energy as compared with the problem as presented to the gas companies, Dr. Hopkinson shows that a gas holder of 7,000,000 cubic feet capacity, such as is now being constructed in Manchester, England, will cost £60,000, and 7,000,000 cubic feet of 16-candle gas are equivalent to 56,000 kilowatt hours. The accumulators capable of storing 10 hours' supply cost about £50 per kilowatt hour, so that the equivalent battery would cost about £280,000. The latter item does not include the allowance which must be made for renewals and repairs; also the further allowance due to the fact that while the gas holder gives back all the energy given to it, the accumulators may be assumed to waste 20 per cent.

Taking up the cost again of an assumed station with 40,000 lights, with accumulators capable of supplying a continuous maximum demand for ten hours, a battery would cost £62,500, and to maintain it and to allow for depreciation, would involve a fixed charge of £12,500 for the batteries alone. The battery, of course, if distributed at various points, would allow the boilers, engines and dynamos, etc., to be reduced one-half, and the conductors correspondingly, since smaller and shorter feeders would be required. The wages also could be reduced. Taking all things into consideration, Dr. Hopkinson arrives at the figure £28,105, as the cost of operating such a station with storage batteries. Curiously enough, this figure is practically the same as that for operating the station without storage batteries, but running light. Thus, in a station of the size assumed, the cost of being *ready* to supply, and to *continue* to supply, is about the same whether accumulators are used or not. The additional cost of actually supplying current is about 40 per cent. more, in the case assumed, where accumulators are used, than where they are not used.

In making this calculation Dr. Hopkinson, of course, takes the accumulator as he finds it, but he is careful to point out that a very little improvement in the cost, durability, and efficiency of accumulators would render them valuable even in very large stations for the mere purpose of diminishing the machinery required. The certainty that accumulators would be improved in time, and largely so, appears to him a strong argument for the use of the direct current, wherever the distance over which the current is to be conveyed is not too great. He also lays special stress on the fact that this calculation is based on the assumption of a very large station, and he does not hesitate to say what has already been, we believe, practically demonstrated, that in most small stations giving a continuous supply, accumulators ought to be used, notwithstanding their expense and defects. Dr. Hopkinson goes so far even as to assert that, in the not very distant future, accumulators will be used in connection with most large stations also.

In considering the employment of alternating currents with transformers, a modification in the calculations would naturally be caused for conductors principally, but on the other side of the balance sheet, would be the cost of the transformers. If the distance were small, increased cost of transformers will exceed the saving in conductors, and vice versa. In both cases the general character of the result will be the same as before, viz., that the cost of being prepared to give a supply will be considerable, and the cost of actually giving the supply will be much smaller than is generally supposed. Dr. Hopkinson concludes that to be ready to supply a customer with electricity at any moment he wants it, will cost those giving the supply not much less than £11 per annum for every kilowatt hour, which the customer can take if he wishes; and afterwards to actually give the supply will not cost very much more than ½ penny per kilowatt hour. This is a very interesting result, and its application to the method of charging customers ought to be closely studied by all central station managers. It will be noted that in the above calculations Dr. Hopkinson has not taken into consideration the question of supplying current for electric motors, which, so far as this country is concerned, is a source of revenue, practically not calculated upon abroad; and as the rates for power per kilowatt hour in the United States are greater than those obtained for the same amount of current when used for lighting purposes, a considerable modification in the calculation would be introduced.

OPENING THE WORLD'S FAIR AT NIGHT.

The question of opening the World's Fair at night has continued to be the subject of agitation and discussion. The management of the Fair, having been invited to reconsider the rule closing the grounds every night at 7 o'clock has done so, but its statements as to a possible opening two or three times a week are regarded as vague and unsatisfactory. What is wanted, and should be given, is an assurance that a portion of the grounds and some of the buildings, will be open regularly at night, including such buildings as Electricity, Fine Arts, etc. The matter has been taken up by the newspapers, and in New York, the *Tribune* and the *Sun* have both expressed themselves in favor of night opening. In view of the immense success of night opening at Paris, in 1889, there is every reason to believe that regular night opening at Chicago in 1893 would be very successful and a great boon.

THEORIES OF SECONDARY BATTERIES.

There is something very attractive, says *Industries*, about the theory of the lead secondary battery, and the subject seems to be a happy hunting ground for scientists afflicted with theories. The conversion of sulphate of lead on both plates to lead on one and peroxide on the other during charge is simple, but it leaves no scope for wild originality. We have, therefore, to put up with all kinds of ridiculous theories—such as those of occluded gases, formation of litharge, and others more complicated. The latest addition hails from the Continent. We are now told that, on charging, sulphate of lead is reduced to sulphide, and the E. M. F. is due to the laudable but eccentric desire of the sulphur to jilt the lead and take up with oxygen to form sulphuric anhydride. We wonder whether this theorist thinks that carbide of lead is formed when carbonate of lead is reduced in a solution of carbonate of soda.

LIVERPOOL OVERHEAD RAILWAY.

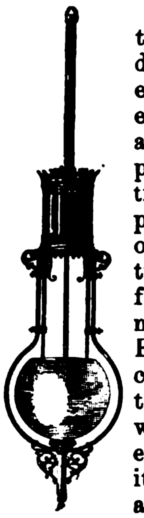
The first train was run on this railway on November 7, carrying the directors and their friends. The trip was satisfactory, the behavior of the generating engines and dynamos being all that was anticipated. There were present the chairman of the Railway Company, Sir William Forwood, and the whole of the directors; Mr. J. H. Greathead and Mr. Francis Fox, the engineers.

Ball Dynamos, and How They Are Made.

BY

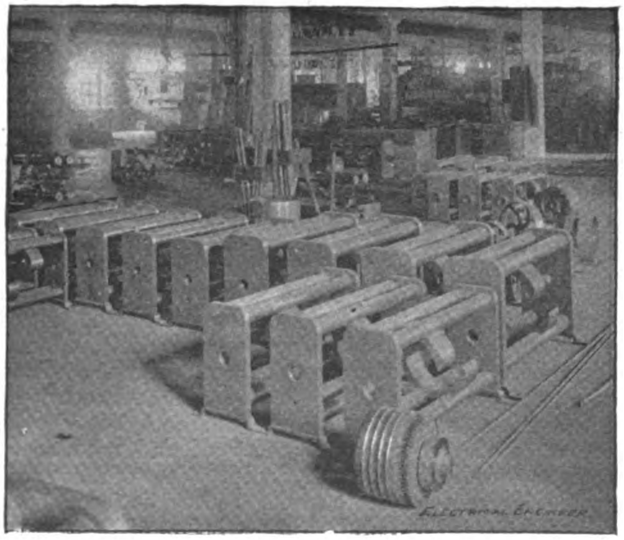
Leslie W. Collins

I.

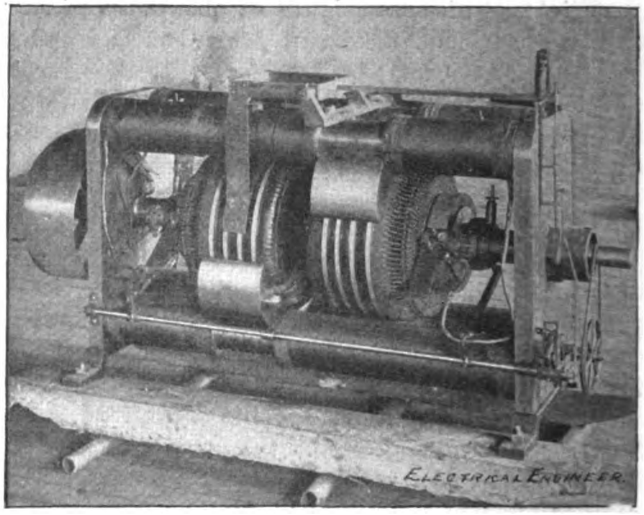

Ball Lamp.

The appearance at the Philadelphia Electrical Exhibition in 1884 of the Ball unipolar dynamo—a machine with two armatures each exposed to a single pole—created one of the most exciting and interesting controversies that ever arose in the field of arc lighting. It was persistently urged by many, including authorities of note, that such a machine could not possibly work; but as it was seen in steady operation for several weeks without interruption, the criticism fell rather flat. It was further objected that the machine, if it ran, must prove very inefficient; but the well-known Franklin Institute tests did not bear out the contention, the only report obtainable after the five days' trial to which the Ball dynamo was put being one that established a high efficiency of conversion—so high, in fact, that it outranked many be-lauded competitors. The arc lighting industry has seen many changes since that time, but the Ball unipolar machine has survived them all, and is to-day the basis of a large and prosperous electrical industry, which has just completed its decade, and of which, therefore, some account will be of more than usual interest.

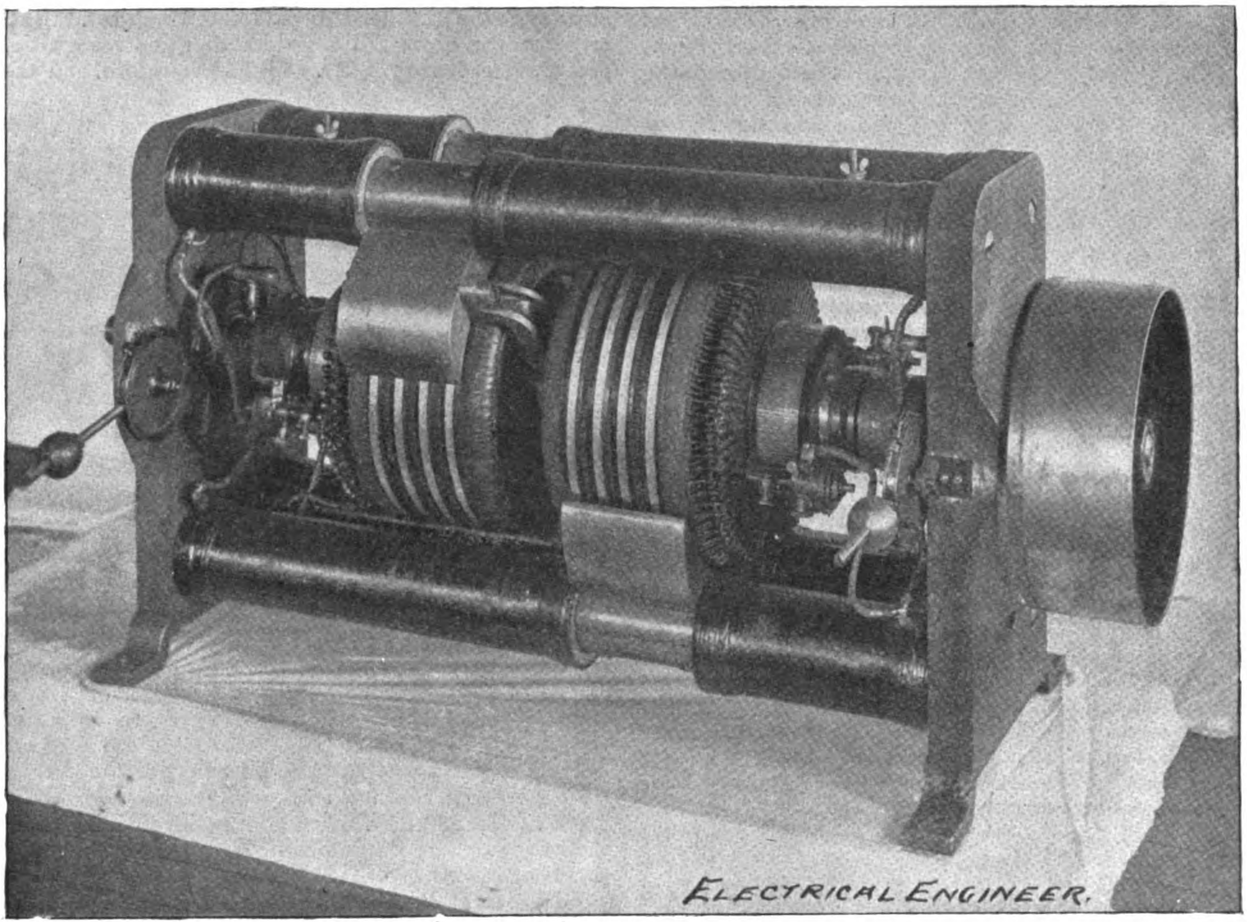
The foundation of the industry was due to Mr. Charles E. Ball, a mining engineer, who, prior to 1880, had taken a deep interest in electrical development, and who, being a man of great inventive genius, had devoted a large portion of his time to the perfection of electrical apparatus for the mining and reduction of ores. He is in reality entitled to the credit of being practically the first mining engineer in America to appreciate the full importance of the changes that electricity was about to cause in the mining industries of the country. In 1880 he made his *debut* as an electrical mining inventor, and produced an electrical plunger and rock drill. But, as we all know, the time was hardly ripe for such things, and a man so far advanced in his ideas passed not merely for an enthusiast but for a fool. He was not intimidated or discouraged, however, but belonged to the class of Maxim, Fuller, Sawyer, Van Depoele, Westinghouse and others, who were attracted from mechanical inventions and mechanical interests by the evidence of great opportunities in the domain of electric lighting; and it was there that he now proposed to concentrate his energies. To this end, he began at once, and very naturally, the construction of his own dynamo. In those days, the ideas of electro-dynamic generation were still very vague, as applied to arc lighting work, and sad havoc with machines was the result. Large dynamos that would operate a long circuit of arc lights in series, without committing suicide in the process, as the result of their own high tension, were very much in demand. Mr. Ball had an idea that the use of two armatures connected in series, each taking its share, would overcome the trouble, and on these lines he constructed his first machine. It did not quite realize his expectations, so he went at it again. After his modifications had been carried out, the machine was reassembled, and a great transformation resulted. Whereas the machine had previously run hot, its armatures were now perfectly cool, and the output was vastly larger, for much less power applied to the pulley. The most striking singularity of all,—half accidental it might be considered,—was that while there had formerly been four poles, or two for each armature, there were now two, placed diagonally across the machine, or one only for each armature. This was the origin of the now celebrated Ball "uni-pole" machine, around whose youth such fierce battle waged, when its originality of design challenged the criticism of the world. As might be expected, the oppo-



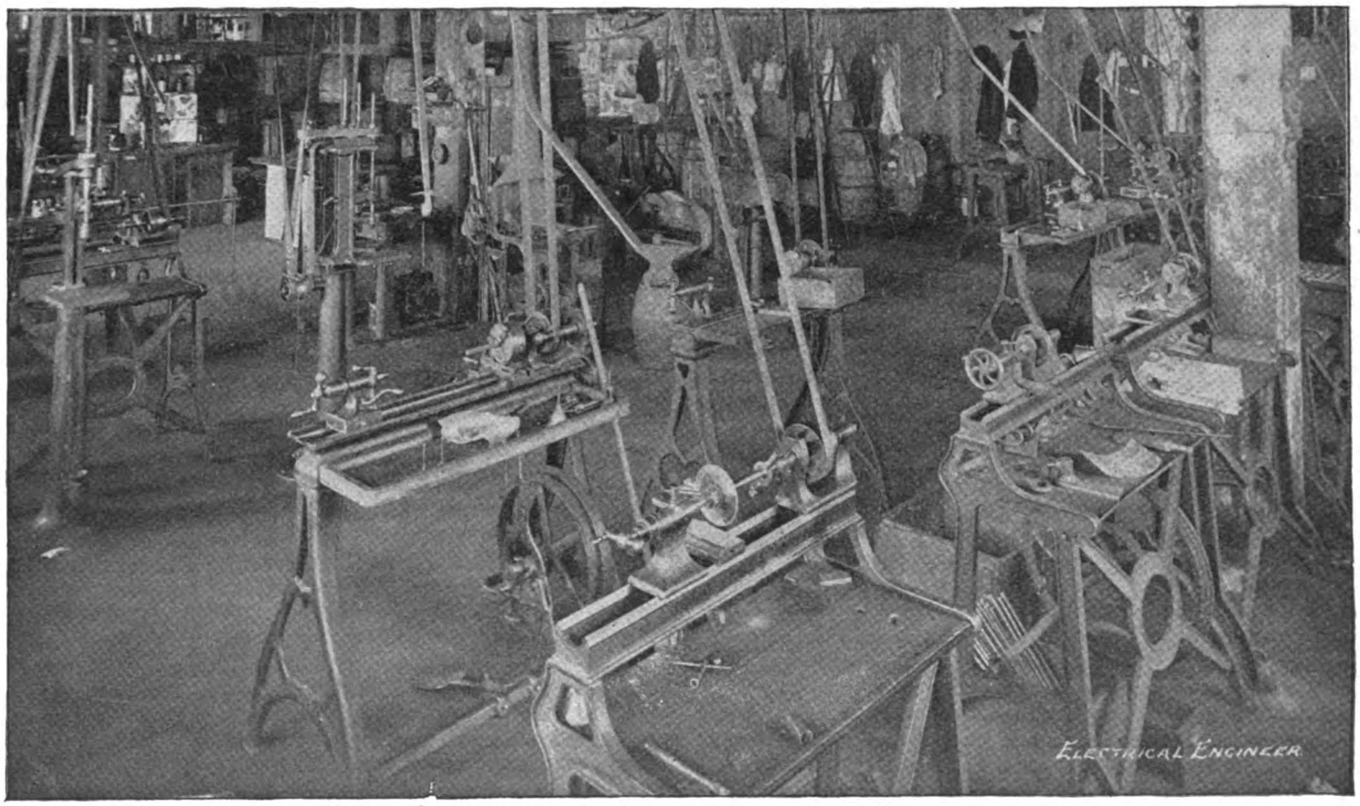
In the Dynamo Assembling Room.



Ball Dynamo Showing Method of Regulation.



Large New Ball Arc Light Dynamo, Showing Counterbalance Regulator.



Department for Making Arc Lamps, Ball Electric Factory.

Royal E. Ball.

sition of experts and theorists, many of whom stood very high, had its effect, and the progress of the machine was slow. But it still did make headway, as a commercial enterprise, on the ground of its high economy, and Mr. Ball persevered in the development of other parts of the system. In 1882, the experimental work and investment of himself and associates were acquired by the Ball Electric Manufacturing Company, which organized under the laws of Pennsylvania, with a capital stock of $200,000.

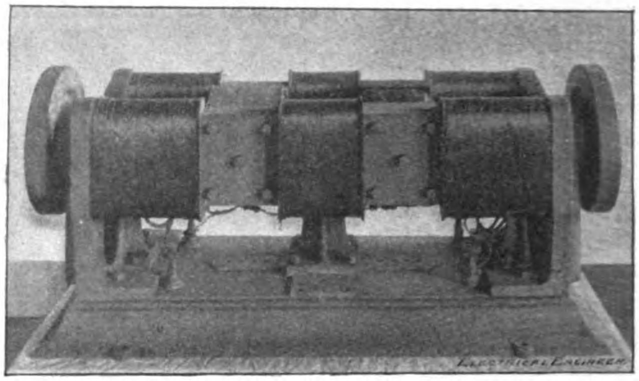
II.

It was thus that ten years ago the Ball dynamo entered a field where demerit is fatal to long-continued existence; and the demand for a machine from which, if needed, two independent circuits could be run, at once became active. Mr. Royal E. Ball, a brother of the inventor, and a civil engineer, graduate of the Rensellaer Polytechnic Institute, of Troy, became identified with the company, as its electrician. A small factory was started at Reading, Pa., and an experimental shop was kept busy in New York City. The first dynamo built by the company for sale was sold for an electric light plant in Mexico, and the first central station on the Ball system was put in operation at Scranton, Pa. That is a long time ago, as electrical history and development run, but it is worthy of note that those first machines are still in active use, giving excellent results; from which it may be inferred that the electrical and mechanical details of the system had been early perfected. The business of the Ball Electric Manufacturing Company was not extensive, but from the very beginning the system stood on its merits, paid its way, and gathered some little surplus.

Charles E. Ball.

III.

As has already been stated, the Ball system was placed on view, in operation at the International Electrical Exhibition of the Franklin Institute, in Philadelphia, in 1884, and at once attracted the greatest attention. A great many other arc machines were there, of more or less merit, but it is safe to say that none was so often or so critically inspected as the Ball, from which a number of lights were run every night. When the International Electrical Congress convened during the exhibition, and the subject of dynamo-electric machinery came up, it was the Ball machine that again came in for an undue share of attention. One of its sharpest critics on the floor of the Congress was Prof. Silvanus P. Thompson, who did not hesitate to reiterate his derogatory opinions later on in the earlier editions of his great volume on "Dynamo-Electric Machinery," the standard book on the subject. But mere criticism can never kill a good thing, and recognition will come, even if tardy. Mr. Ball has therefore had the satisfaction of seeing that while Prof. Thompson, with an Englishman's tenacity, is slow to give up his views as to the correct theory, he is compelled to admit the practical merits of the Ball "unipole" machine, for his last edition (page 477) says: "It remains, however, to be stated that in spite of these imperfections of design, *the Ball machine has given great satisfaction, its construction having evidently been carried out with good engineering skill.*" The proof of the pudding, if we may believe an old adage, is in the eating. The Ball machine is one of the few that have survived the stress of time and progress, and one of the few which, seen at Philadelphia in the Electrical Exhibition in 1884, will go with colors flying and the trophies of victory to the Chicago Exhibition of 1893.



FIRST BALL DYNAMO, 1881.

IV.

To complete the historical sketch that has been given of the development of the Ball system and industry, it should be mentioned that in 1886, the interests of the Ball Electric Manufacturing Co. were bought out by a corporation formed under the laws of New York State, called the Ball Electric Light Co. A factory was thereupon established in this city, on Second avenue. The business of the new company increased so rapidly that it soon became evident that larger and more desirable quarters must be moved into without delay. To this end the company secured early in the year 1886, a large four-story manufacturing building on the corner of Ninth avenue and Twenty-seventh street, where it is still in occupation. This desirable building has a frontage of 200 feet on Twenty-seventh street, and 100 feet on Ninth avenue, the location being on a corner, insuring perfect light, ventilation, etc. Nearly everything necessary for the establishment of a first-class manufactory was already there,—for instance, a large battery of first-class boilers, Corliss engine plant aggregating over 150 h. p., freight elevators, and in fact everything needed to start at a moment's notice. Once in this building with the admirable facilities at hand, the company was in a position to

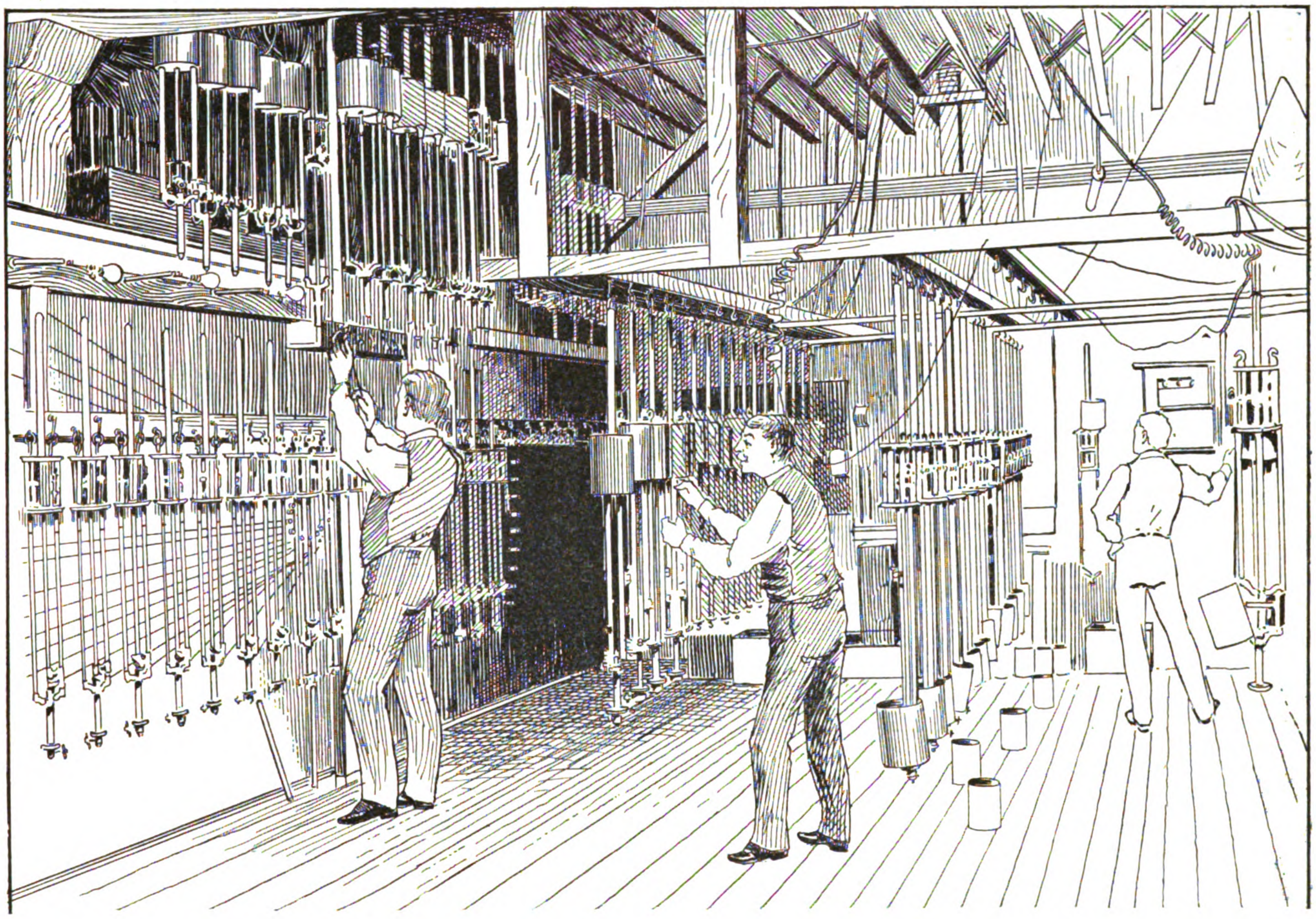
W. A. Nicholson.

accept and fill without any delay all orders for apparatus with which it was intrusted, and thus entered on its present career.

V.

Coming to a brief description of the factory before passing on to the apparatus itself, I would remark that electrical factories such as this is are rare examples of steady application to the production of one thing. Passing in at the main entrance, which is located on the Twenty-seventh street side, we proceed to the third floor. This may, in reality, be called the main floor of the factory, as on it is located a desirable suite of offices. A partition running along the north or Twenty-seventh street side affords an allotment of space for the said offices, which combine general, private, and managers' offices. The office of the superintendent Mr. W. A. Nicholson is also on this floor, as most of his time is spent here. This floor, as our illustration shows, is very large, being an entire open floor of the building 100 by 200 feet, and contains the large lathes, planers, turning and boring machines necessary in the construction of the dynamo. The assembling department is also on this floor with a convenient testing room close at hand. The assembling room occupies a desirable space in the centre of the main floor within easy reach of the machine department. The illustration of this room gives a good idea of a number of the Ball dynamos in waiting for the armatures, and final connections. We are afforded here an excellent opportunity of inspecting freely and closely the Ball automatic regulator, and the special automatic machine, the regulating part of which is entirely self-contained. This last machine is claiming a great deal of attention just at present, and the Ball people believe that they stand first in the field with this particular type of dynamo.

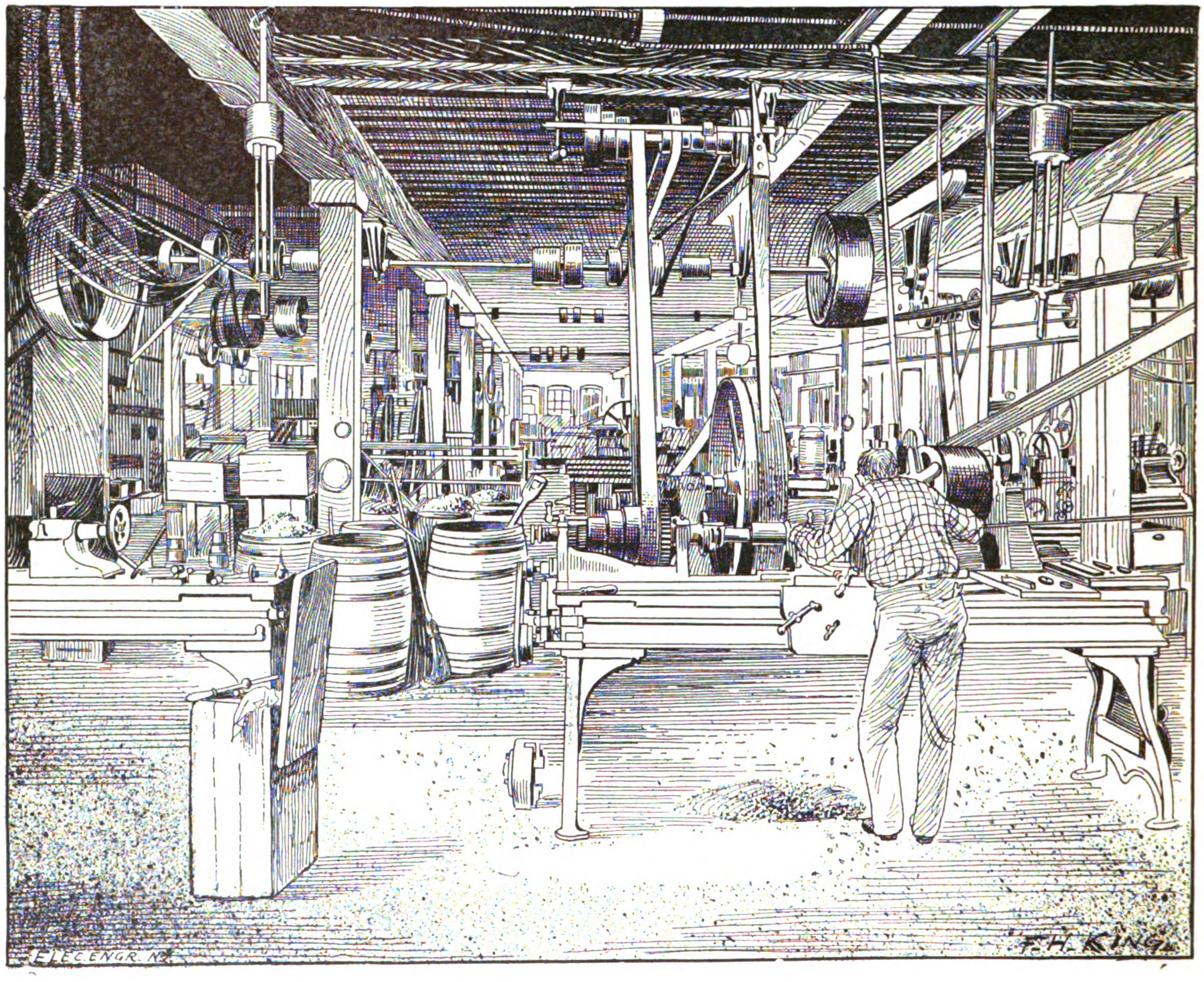
The Ball Company manufacture also all the arc lamps for use in their system, and have a splendidly equipped department, occupying a space of one of the floors of the factory about 70 by 70 feet square. This room, facing as it does on the north of Twenty-seventh St. and on the West on Tenth avenue, gives the workmen what is most needed in the construction of the more intricate parts, that is, excellent light. This portion of the factory is capable of turning out over forty complete lamps every day. On this same floor is located a well-adapted armature-room, having a number of large windows on two sides, giving excellent light and ventilation. There is ample room in this department for at least fifty trusses or stands for armature winding. The testing-room, still another important department, is also located on this floor, and is one of the most complete departments in the factory. It is here illustrated. This room is an adjoining one to the lamp manufacturing department, and has a capacity for the hanging and testing of about 200 lamps at one time.


In the Lamp Testing Department.

A most novel and interesting lamp has recently been placed upon the market by the Ball Electric Light Co., and may be here spoken of. It is an all-night lamp, with a reciprocating carbon attachment. This lamp has all the familiar advantages, it is said, of the double, triple, and disc carbon lamps, but at the same time is entirely free from the unreliability of complicated mechanisms. To obtain the protracted burning, an attachment is placed upon the regular Ball arc lamps, which produces the swinging or reciprocating of the top or positive flat carbon across the lower or round carbon, the former being made with a greater cross-section than the later. Thus, as the upper carbon wastes away and is fed to the arc it is periodically fed across the arc so as to consume one portion after another. The illustration of this particular lamp which we present is so nearly perfect as to be almost self-explanatory.

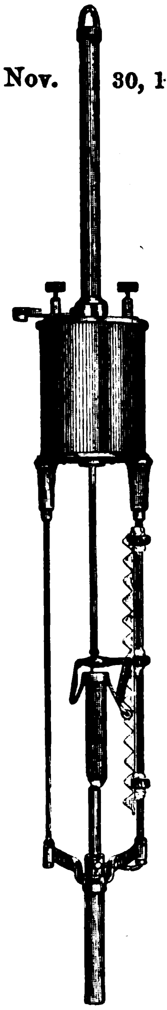
VI.

Like all of its competitors, the Ball dynamo was, no doubt, a little crude at first, but as improvement has been the all-important point in the development of electrical interests, the Ball Electric Light Company have kept abreast of the times, and have from time to time added perfections and left out discovered imperfections in their dynamo, so as to have a machine which could be classed second to none at present manufactured.



Vista of the Main Machine Shop, Ball Factory.

The Ball machine during all these years has gained its reputation and business on its merits as a dynamo. Until recently the company have refrained from the manufacture of a dynamo having automatic regulation, their claim being that their dynamo without an automatic regulator was superior to any dynamo with it. In order to enlarge its range of manufacture, and to meet the wishes of those who wanted machines with automatic regulation, recently the Ball Company have perfected and are now placing on their dynamo an automatic regulator of new and novel construction. By reference to the illustration of the Ball dynamo with automatic regulator, it will be seen that the armatures each revolve in proximity to a single pole piece, leaving one-half of the armatures as exposed parts. An armature in answering its purpose as a generating device is, at the same time, to a certain extent at least, a magnet having its field of force responding to the rising and falling of the main current through the armature. A small magnetic bridge is placed over the exposed parts of one of the armatures as an external magnetic circuit between the two poles of the armature. By a combination of levers, this bridge is connected to a step-by-step motion which operates the brush-holding yoke and moves forward or backward according as the field of force of the armature varies from the rising or falling main current flowing through it. It can be seen by this short description that the Ball Company have a simple, uncomplicated and what should be, a positive regulator. Not content with this, however, they have gone beyond, and have perfected and are placing on the market a self-contained, automatic dynamo. It is simply a trifling modification of the regular Ball dynamo. The automatic feature or principle is at once self-contained and without external mechanism or complications whatever. Trifling changes are made in the shape and size of some few of its parts. The yoke or brush-carrier is made of a magnetic material, and extends backwards in the shape of a disc to fit loosely into a cored-out part of the end frame.



Ball Reciprocating Lamp.

Thus, the yoke is at the same time a brush-carrier and a movable part of the main magnetic circuit. This yoke is supported by ball bearings and is so constructed as to have two axes of different magnetic reluctance and at right angles to each other. Of course, the tendency of the yoke is to set itself with the axis of least magnetic reluctance parallel to the magnetic flow through the end frame. This tendency is counter-balanced by the proper disposition of weight (see illustration of the "Ball Automatic Dynamo"), and accordingly the yoke with its brushes responds to changes of magnetic flux, thus maintaining a constant field and current. Its action is direct, positive and instantaneous from full load to no load.

VII.

The Ball Company continue to pay especial attention to their 800 c.p. arc lamps, which have a consumption of four amperes and an E. M. F. of 49 volts, and they maintain their claim to give over three lights per horse power. This the company believe due to their double armature and the finer or high tension winding. The double armatures actually produce two currents or circuits, thus dividing the tension and necessarily the load, whereas in other machines the one armature is compelled to bear the whole load. This, at any rate, is no experiment with the company, as they have been selling the four ampere system for six years and undertake to guarantee the above results to purchasers. The Ball Company have also just completed what is asserted by them to be the largest arc dynamo ever built. This machine has a capacity of 120 full 2,000 c. p. lamps. The machine is, of course, a regular Ball two armature machine with the self contained regulating device. It is practically a two circuit machine with 60 lights on each circuit, and being automatic at both ends, permits, in case of any posible accident to either armature, the running at a high speed of the uninjured one, thereby insuring a capacity under these conditions of at least 90 lights. This machine has 3,000 volts on each circuit consuming ten amperes. The facilities of the company at the present time are such that almost any sized machine and its regular complement of lamps can be secured within at least thirty days' time.

VIII.

In closing my article, I should add that the Ball Company have manufactured and sold a good many 8 and 10 ampere dynamos and lamps, additional to those of which I have ventured to give a more detailed description. They have also had occasion to supply frequently their Ball series system for long-distance incandescent lighting, and have now upwards of 10,000 such lamps on Ball circuits in this country, Canada, Mexico, Central America and South America.

At the present time the affairs of the company are managed by W. L. Brown, president; Chas. E. Ball, vice-president and general manager; R. E. Ball, electrician; Geo. R. Cullingworth, treasurer, J. S. Bell, secretary, and W. A. Nicholson, superintendent. Of the latter gentleman I have also given a vignette portrait, and I wish to take the liberty here of acknowledging the many courtesies received at the hands of Secy. J. S. Bell, Supt. Nicholson and the Messrs. Ball, in my inspection of the factory and the apparatus.

ELECTRIC RAILWAY DEPARTMENT.

THE NEW RAE CAR MOTOR EQUIPMENT.

BY

Frank B. Rae

SOME four years ago at Elkhart, Indiana, the first attempt was made to equip a street railway with single motors geared to both axles, the plan proposed by the writer being one in which a rigid frame supporting the motor and countershaft was carried upon the axles, and the power transmitted by bevel gearing from the countershaft to the car axles. This method of applying the power was criticised, particularly by the builders of two other motor systems, who predicted failure on account of the rigidity; but the advantage of a single motor driving both axles seemed sufficiently great to warrant a thorough test, and some forty roads equipped with the Rae system demonstrate the success of the single motor. Extreme rigidity of the motor carrying frame and perfect alignment is necessary to keep the bevel gears in proper mesh; at the same time sufficient spring in the whole arrangement must be allowed to avoid lifting one wheel of the truck on curves, and when this condition is not exact, broken gears and other troubles immediately ensue.

To more thoroughly overcome the difficulties and objections to the rigid method of driving both axles from a single motor and at the same time obtain the advantages of flexibility claimed by employing a motor on each axle the writer has brought out the arrangement illustrated below. While the bevel gearing has been adhered to, all the other features of the Rae system familiar to the readers of this journal have been greatly modified.

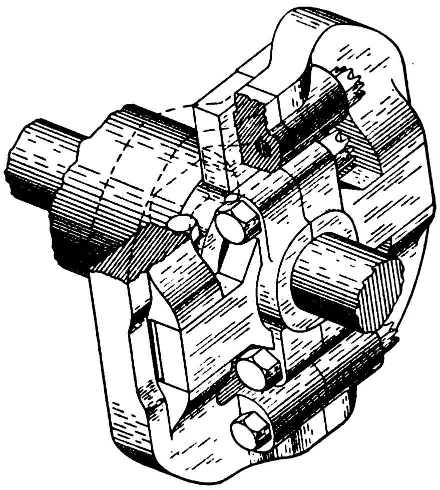


FIG. 3.—FLEXIBLE COUPLING, NEW RAE CAR MOTOR.

The frame heretofore used has been dispensed with, and the motor itself forms the frame and is directly supported on the axles, as shown in Fig. 1, which represents a plan view of a 40 h. p. truck equipment. The countershaft is dispensed with, the motor being of the slow speed type and geared direct between the armature shaft and car axles. At one end the bevel gear is directly upon the axle, while at the other it is mounted upon a sleeve or quill in bearings which are a part of the motor frame. This quill end of the motor frame rests upon springs, which relieve the motor greatly of jar and consequent crystallization, and permit the axle within the quill to take any position without putting any twisting strain upon the motor. This construction is seen in Fig. 3.

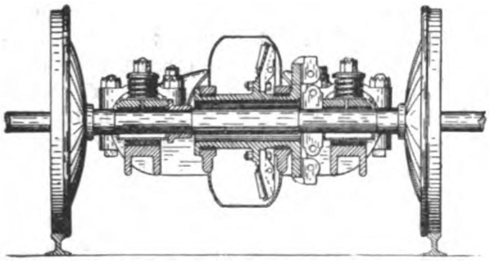
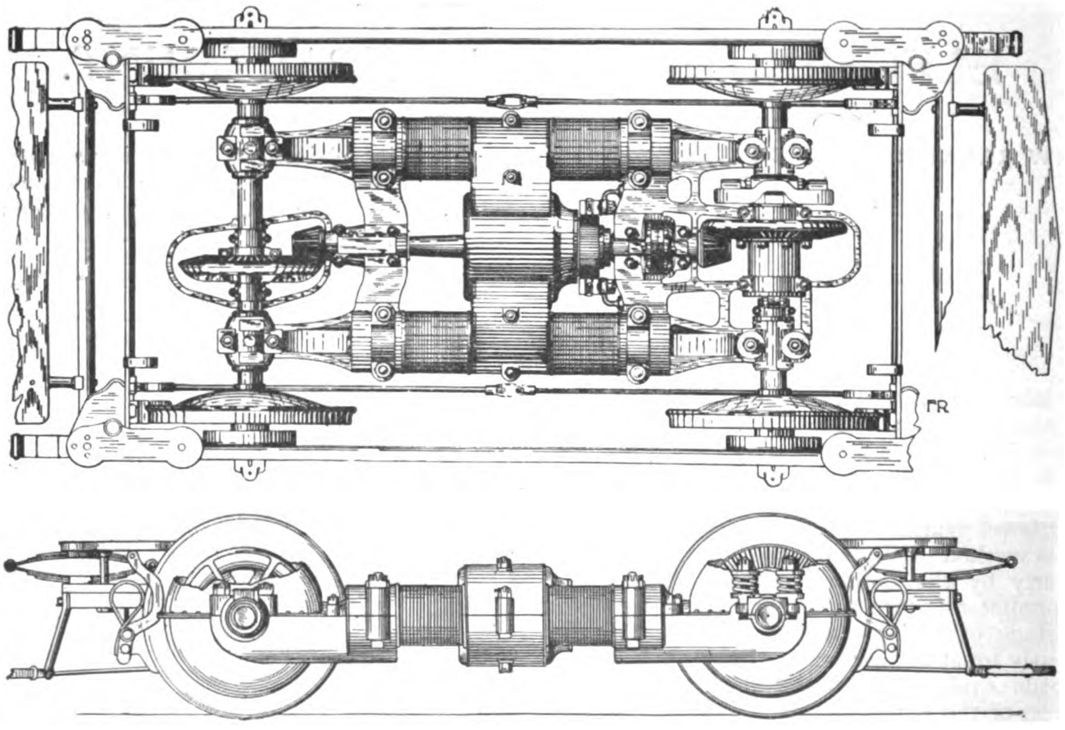


Fig. 4.—New Rae Car Motor—End View.

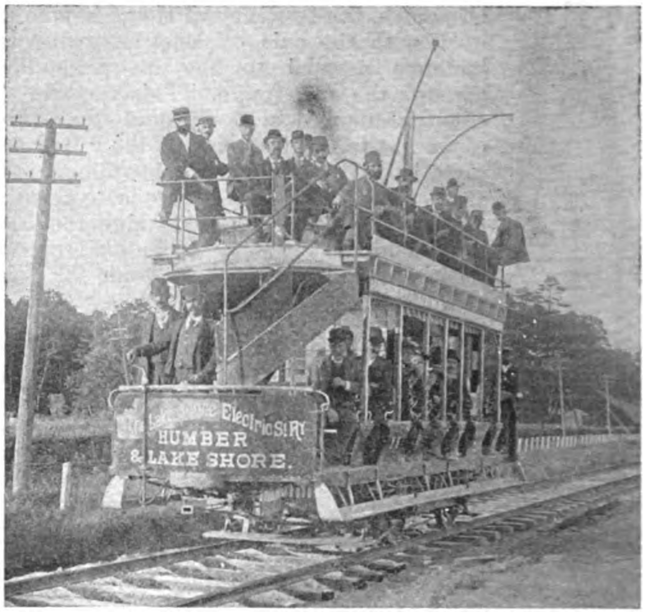
The power is transmitted to this axle by means of a flexible coupling between the quill and axle, and will be understood by reference to Fig. 3, which is an isometrical drawing of the coupling. This device consists of three parts, the first being clamped to the axle and provided with two projections which fit loosely into recesses in the second part. Upon the quill is clamped a piece with two projections similar to that upon the axle, the projections also fitting into the second part, but at right angles to the other. It will thus be seen that the axle may take any position in relation to the quill and still drive without altering the angular velocity between the quill and axle and without cramping the motor frame or affecting the gears; the work upon the gears being in proportion to the duty at any point of rotation.



Figs. 1 and 2.—New Rae Single Reduction Car Motor.—Plan and Side View.

Upon the rear axle, or the one to which the gear is directly attached, the motor bearings are held from movement endwise by a thrust bearing formed directly upon the axle, similar to that used upon propeller shafts, which effectively prevents any shifting of the motor upon the axle.

The field magnets of the motor are of round wrought iron to which the pole pieces, each formed of two parts, are cast and bolted to the field pieces. The magnet yokes which also form the supports upon the car axles as well as the boxes for the armature shaft are in one piece. This construction reduces the entire motor to eight distinct pieces plus the armature and gears. These eight pieces are put together with 12 bolts, and the locked nuts for these bolts are all upon the top and accessible through the traps of the car. As will be seen by the side elevation, Fig. 2, the clearance between the motor and ground is greater than in other single reduction equipments.



Double Decked Car with Rae Motor Equipment.

The electrical design of the motor has been carefully worked out, the efficiency agreeing with that of the best design. The motor proves upon extreme work to be absolutely sparkless with any load. The rise in temperature in field coils, armature and commutator is hardly perceptible after a full day's duty. Contrary to the usual practice of rating street car motors, this equipment is designed to furnish its full rated horse power continually and not intermittently.

The first road to equip with the new Rae system is the Toronto & Mimico Electric Railway, a suburban line along the lake shore near Toronto, Ontario, operating only during the summer months. Double deck cars are used which are mounted upon McGuire trucks.

RAIL BONDING AND MEASURING GROUND RESISTANCE.

BY

Franklin Sheble

Electric railway engineers must have read with interest the article on "The Resistance of Return Circuits," in The Electrical Engineer of Nov 9. In it Mr. Warner has brought out fully the importance, and even the necessity, in roads of average size, of relying on the rail as a conductor for the return current, rather than laying expensive supplementary wires for this purpose.

In using the rail, the important question is—How to secure good bonds between the rails? The bonds connecting the rails must be of sufficient size to carry the total return current in case one of the bonds on the opposite rails should loosen or break. The bonds joining the rails of a single track road should be cross-connected at each joint, and if the road is double track, the two tracks should, in addition, be cross-connected at every 500 feet, or oftener, according to the amount of traffic.

It has recently been proposed to use a galvanized iron cable, about three feet long and ¾ inch in diameter for bonding rails. This should be carefully connected to the rails; a good way is to use a split plug, and drive the plug, with the cable in the centre, into a hole in a web of the rail, care being taken that all surfaces are bright.

The use of iron for bonding rails has been objected to, on the ground that it will corrode and be eaten away more rapidly by electrolysis. If the iron cable proposed is galvanized, and if the cable and the joints are well coated with pitch or asphaltum, the life of the bond should be as long as the life of the rail.

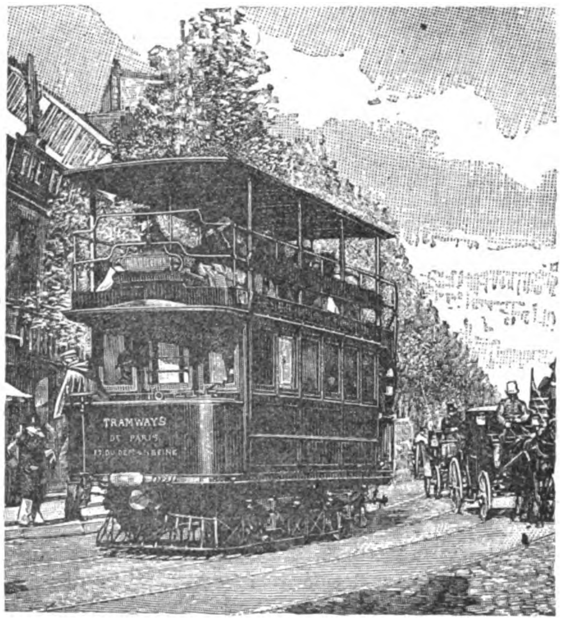
In the paper referred to, Mr. Warner used the top wire of a barb wire fence for the potential wire. I would suggest that one of the guard wires be used for this purpose. I have measured the resistance of the ground circuit in the same manner as given in the article mentioned, with the exception that a motor car and trailer were run out on the road after all the other cars were in for the night. Through the kindness of the local telephone company, a direct connection was made from a subscriber's telephone along the road through the telephone exchange to the power station. A connection was made from the line side of the subscriber's telephone through a high resistance voltmeter to the rail, and from the line side of the telephone at the power station to the ground side of the generators. The connections through the central exchange was made from line to line. These connections were made for five minutes and then disconnected, in case any one wished to telephone to either party, and made again, until perhaps a dozen readings could be taken. The brakes were set on the cars, current put on the motors, and ammeter and voltmeter readings taken. Simultaneous readings were taken on the instruments in the car and on the voltmeter in the rail circuit. The voltage at the power station was kept constant. The difference between this voltage and the voltage around the motors gave the drop in both line and rail circuits. The difference between this and the drop in the rail circuit gave the loss in the line. The resistances of the line and rail circuits are determined, knowing the current. In this way the resistance of the line and rail circuits can be determined at different points along the route of the road, at any distance from the power station.

The importance of having private telephone lines run from the power station to different parts of the city, in case of accident on the line, has often been brought up. These same lines can easily be used as potential wires at different times during the day, and the drop in the rail or line circuits read at the power station. Connections can be made from the telephone stations through a portion of the guard wire to other sections of the line or rail, and by this means the drop in the different circuits can be determined exactly, and copper added to the line, or grounds added to the rail, as conditions require.

STORAGE BATTERY CARS IN PARIS.

As already announced by us, the Compagnie des Tramways de Paris et du Department de la Seine have recently put into regular operation storage battery cars on their line running from the Madeleine to Saint Denis. A view of one of these cars, taken from *La Nature*, is shown in the accompanying engraving. It has seating capacity for 56 persons, and is double decked. The storage battery charging station is situated at Saint Denis, and the current is furnished by two Desroziers 60 kilowatt-machines running at 600 revolutions, and furnishing 200 amperes at 260 volts. A third dynamo of like capacity is kept in reserve.

The accumulators employed on the cars are manufactured by the Société Anonyme pour le Travail Electrique des Metaux and are of the Laurent-Cély type, built at the works of the company at Saint-Ouen-les-Docks. They consist of 11 lead plates, 200 mms. square, and have a total active surface of the positives of 40 square decimetres. The external dimensions of each accumulator are 37 cms. high, 37 cms. long, and 23 cms. wide. The normal charging rate is 17.6 amperes, and the maximum 35.2 amperes. Under the same conditions the discharge is 26.4 and 52.8 amperes. The available capacity is 264 ampere hours at normal discharge, and 158 at the maximum. The accumulators are placed in wooden boxes, 9 in each box, and 3 boxes constituting one battery. Each car carries 4 batteries of 3 boxes, thus making 108 cells to the car.


TRAMWAYS
DE PARIS
ET DU DEPT DE LA SEINE

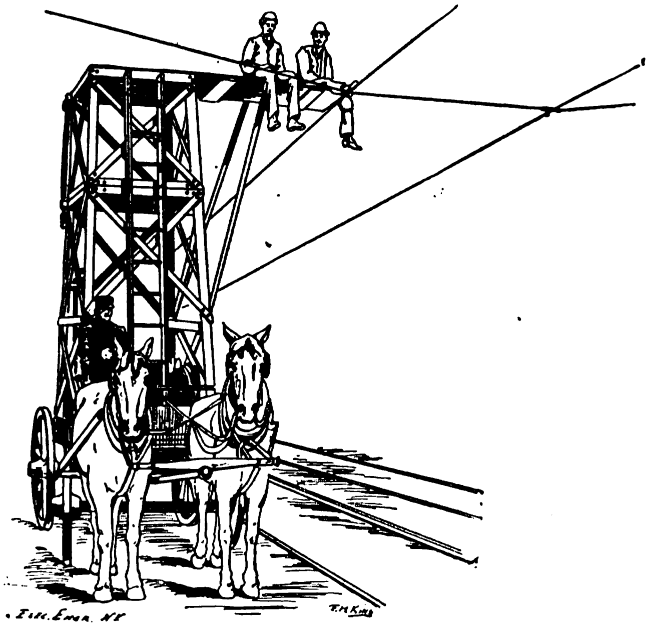
A Paris Storage Battery Car.

The motors are designed to operate at 200 volts and 50 amperes running at 1,300 revolutions per minute, which is reduced by gearing at the car axle to 108 revolutions per minute. The usual switch is provided for connecting batteries in various combinations for obtaining the different speeds required. Within the city of Paris a speed of 7½ miles per hour is permitted, while beyond the fortifications 10 miles per hour is allowed.

THE PETERSON TOWER WAGON ON THE MONTREAL STREET RAILWAY.

BY L. M. PINOLET.

It is necessary that the tower wagons at present in use for street railway construction or repair work should stand directly under the wire at which the men are working and, consequently, when such a wagon is employed for work on a trolley wire it must stand on the track and whenever a car passes the men have to stop their work while the wagon is hauled to one side to allow the car to go by. These interruptions interfere with the work of the men and if the cars pass frequently, cause a considerable loss of time.



PETERSON TOWER WAGON ON THE MONTREAL STREET RAILWAY.

To obviate these delays, the Montreal Street Railway Company in the introduction of the trolley system on its lines, is using most successfully an ingenious and simple extension tower wagon designed by Mr. A. Peterson, lately with that company. This wagon differs from the ordinary tower wagon in being provided with an extension, and when used for work on a trolley wire stands at one side of the track where it is out of the way of the cars, and thus the men can work without interruption, as this wagon does not have to be moved from its position to allow a car to pass.

As appears from the illustration, which shows two men at work on a wire, the cars can pass meantime on the track beneath. This wagon and its tower are like those in general use, but are of a somewhat heavy construction in order to secure stability. The tower at its base is 6 feet by 4½ feet, and at its top is 3 feet 3 inches square. The total height from the ground to the top of the tower is 16 feet. The extension is a light wooden platform, 5¾ feet by 3 feet projecting over the track sidewise to the tower, to which it is attached by two iron hooks that catch in rings on the top of the tower. Two wooden supports serve as brackets to sustain the extension in a horizontal position and are provided at their upper ends with hooks that catch in rings near the outer edge of the platform and at their lower ends have iron tongues that fit in rings on the tower near its base.

The extension can be folded up against the tower, by lifting the tongues out of the rings, lowering the platform and then detaching the supports by unhooking them, when the extension will hang down close against the tower. It can be removed entirely by simply unhooking it from the rings in the top of the tower and, in the same manner, may be put up at the other side of the wagon where rings are provided for this purpose.

AN ELECTRIC RAILWAY PROJECT AT INDIANA, PA.

MR. JOHN L. PAUL, the secretary of the Indiana (Pa.) Electric Company, writes us as follows: "The matter of building an electric railway 28 miles long between this town and Punxsutawney, Pa., is being discussed, and we invite interviews with electric railway people to this end. The proposed line would pass through a very good farming district and would tap about six small towns not now having any railway facilities whatever. It is believed that the matter of freights would alone be enough to warrant the building of the road without taking the passenger traffic into consideration. The writer of this can be addressed in regard to it and will give all the information in his power, and will, if desired, go over the proposed route with railway people."

MISCELLANEOUS.

THE PARSONS CONDENSING STEAM TURBINE.

PROF. EWING, of Cambridge, England, has just made public a series of tests conducted by him last August, upon the Parsons condensing steam turbine, using moderately superheated steam, by means of which very remarkable results are obtained.

TABLE I.

Trials with Continuous Current Armature, with Steam Superheated by the Gases from the Boiler Fire only.

Pressure by gauge on boiler, lbs. per sq. in.	Temperature of steam, ° Fah.	Load in electrical units per hour.	Feed-water per hour in lbs.	
			Total.	Per unit.
96	335	0.1	480	—
102	365	10.2	760	74.5
100	356	27.0	1110	41.1
102	400	49.2	1590	32.3
100	390	74.5	2170	29.1
103	398	102.0	2900	28.4

TABLE II.

Trials with Continuous Current Armature, with Extra Superheating.

Pressure by gauge on boiler, lbs. per sq. in.	Temperature of steam, ° Fah.	Load in electrical units per hour.	Feed-water per hour in lbs.	
			Total.	Per unit.
102	463	28.3	1060	37.5
102	468	49.5	1480	29.9
101	465	78.4	2170	27.7

The dynamo tested was one of the type shown in the accompanying illustration, Fig. 1, for which we are indebted to our contemporary, *Lightning*, which represents an actual machine destined for the central station at Cambridge. It was primarily constructed to generate alternating current up to 50 amperes, at a potential of 2,000 volts, but in order to put the electrical measurements beyond range of dispute, a continuous current armature, giving 400 amperes at 250 volts, was specially wound for these tests as well, the results obtained with the two armatures being afterwards found to correspond closely.

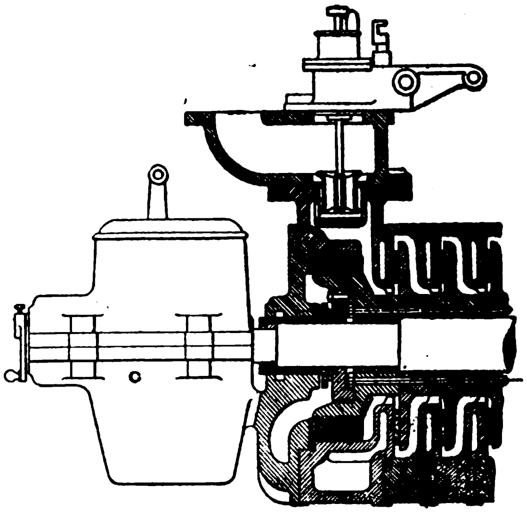


FIG. 2.—PARSONS CONDENSING STEAM TURBINE.

The turbine used, a section of which is shown in Fig. 2, contains on its shaft seven revolving discs, each of which carries on one surface several concentric rings of brass blades, traveling in spaces between rings of fixed blades carried on annular discs fixed to the outer case. Thus each revolving disc with its next fixed disc forms a series of outward flow turbines, the steam entering inside the smallest ring and traveling up to the circumference, thence over and down to the centre of the next disc, and so on to the end. The discs, the blades, and the spaces between the blades are so arranged as to allow for full expansion of the steam in its passage from 115 lbs. pressure per square inch to an absolute pressure of 1 lb. per square inch.

TABLE III.

Trials with Alternate Current Armature and Water Resistance Superheating by the Gases from the Boiler Fire only.

Pressure by gauge on boiler, lbs. per sq. in.	Temperature of steam, ° Fah.	Load in electrical units per hour.	Feed-water per hour in lbs.	
			Total.	Per unit.
99	367	31.6	1180	37.3
97	394	49.9	1550	31.1
103	399	105.2	2970	28.2

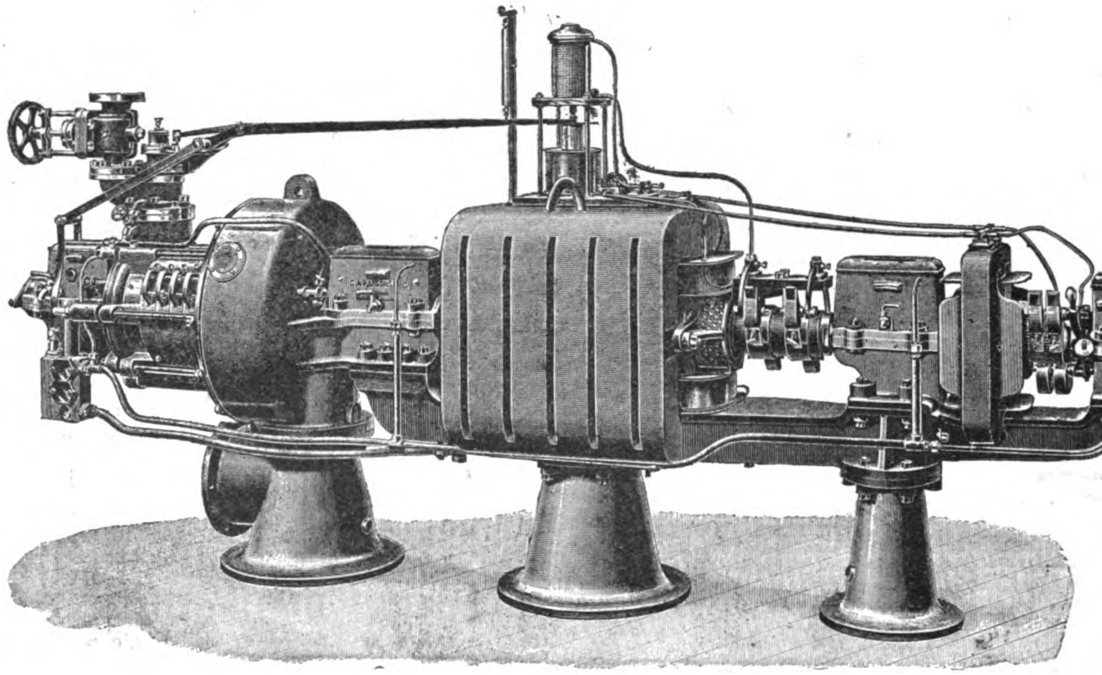


FIG. 1.—PARSONS CONDENSING STEAM TURBINE WITH DYNAMO.

The governor consists of a steam relay, in mechanical connection with the turbine shaft, which opens a double-beat lift valve, shown in Fig. 2, once in every 28 revolutions of the shaft. Thus the steam is admitted in periodic gusts. The duration of these gusts is controlled by a solenoid coil, connected as a shunt to the field magnets, and compound wound, so as to keep the volts constant. Attached to the core of this solenoid is a lever, the movement of which affects the action of the valve in such a way that at full load the admittance is almost continuous, whilst at light load it is quite intermittent.

The longitudinal pressure on the turbine shaft, due to the one-sided character of the six smaller turbine discs, is balanced at the high-pressure end by a revolving baffle piston with a number of deep grooves on its circumference, which are entered by corresponding projections on a fixed bush resembling a thrust-block. Any small amount of longitudinal thrust which may remain unbalanced is received by an adjustable grooved thrust bearing at the end of the spindle, beyond the main bearing.

The accompanying tables show three separate sets of trials made.

In the third set of trials the alternate current armature was used, giving 2,000 volts at a speed of 4,800 revolutions per minute, which made the frequency of alternations 80 periods per second.

The electrical energy was absorbed by a water resistance, the steam being moderately superheated as in the first set, up to about 400° Fahrenheit. The results are given in Table III. The close agreement of them with the corresponding continuous current trials, Table I, is important, as supplying evidence that in alternate current trials conducted in this manner the effects of lag in the external circuits are immaterial. The difference between the alternating and continuous current measurements is less than 1 per cent. of the output at full load.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED NOVEMBER 15, 1892.

Accumulators:—

Secondary Battery, R. Eickemeyer, Yonkers, N. Y., 486,091. Filed April 4, 1890.

Employs battery plates insulated from each other and arranged in a pile, the plates having corresponding openings through them which afford spaces for occupation by the fluid.

Alarms and Signals:—

Test Circuit for Burglar-Alarm Systems, E. R. Wilder, Kansas City, Mo., 486,149. Filed Aug. 22, 1891.

Police Signal System, J. C. Wilson, Boston, 486,206. Filed Oct. 14, 1887.

Electrical Annunciator, F. S. Carter, Burlington, N. J., and G. B. Stumpf, Philadelphia, 486,213. Filed Aug. 13, 1891.

Has for its object to reset the pointer by means of the current operating the annunciator at the time the return call is made.

Messenger-Call System for Buildings, F. H. Fuller, Springfield, and C. B. Perkins, Holyoke, Mass., 486,282. Filed April 5, 1892.

A system in which a single centrally located call box serves the purposes of a number of different individuals, by means of an inductor adapted to be set to designate any one of several rooms.

Electric Alarm, H. A. Hull, New Brunswick, N. J., 486,333. Filed April 30, 1892.

Invention consists of a rod having a contact point adapted to pass successively over the opposite faces of a contact spring, one of the faces being insulated.

Electro Magnetic Bell, J. J. Ross, Detroit Mich., 486,354. Filed December 29, 1891.

The armature is evenly poised between two or more electro-magnets so as to be unaffected by the inequalities of the magnets or the variations in the power of the battery.

Galvanic and Thermo-Electric Batteries:—

Electric Battery, J. J. O'Lalor, Boston, Mass., 486,264. Filed Oct. 3, 1891.

A battery in which the connections are automatically made by the act of placing the cover in position, and having a small motor or other device mounted upon the cover.

Distribution:—

Circuit Controller, H. W. Leland, Jersey City, N. J., 486,212. Filed Jan. 11, 1892.

Employs a disc provided with one or more elastic ridges and circuit controlling contacts embedded in the ridges.

Dynamos and Motors.

Electric Locomotive, W. E. Allington, E. Saginaw, Mich., 486,038. Filed June 9, 1891.

Provides means for varying the ratio of the speed of the motor to that of the driving-axle to facilitate starting.

Armature for Dynamo Electric Machines and Electric Motors, C. S. Bradley, New York, 486,078. Filed Nov. 17, 1890.

A drum-armature employing individual coils of windings placed in slots and held by their own mutual binding action.

Governing Electric Motors, R. Lundell, New York, 486,213. Filed Dec. 19, 1891.

Employs a motor whose armature and field magnet are each wound with independent sections of coils, and circuit changing devices for varying the series and relations of the coils.

Governing Electric Motors, R. Lundell, New York, 486,214. Filed Jan. 2, 1892.

Invention consists in providing a motor with several field magnet and armature coils, connecting the motor to a three wire supply system, and switching the coils in such a manner that the desired changes in speed shall be attained.

Armature for Dynamo Electric Machines, A. L. Parcelle, Boston, Mass., 486,234 Filed Nov. 7, 1891.

Employs an armature having apertures for containing the coils; each coil being composed of a number of independent insulated lengths of wire.

Regulator for Dynamo Electric Machines, A. Dow, Elgin, Ill., 486,417. Filed Mar. 20, 1891.

The combination of a pulsating current dynamo with a regulator adapted to vary the current in the field responsive directly to the varying range of pulsation of such current; the field magnets and regulator being independent of the main working circuit.

Lamps and Appurtenances:—

Regulable Electric Lamp, G. W. Hall and J. J. De Marr, Georgetown, Colo., 486,334. Filed Dec. 1, 1891.

Employs several filaments of different resistances.

Electric Arc Lamp, D. Higham, Boston, Mass., 486,377. Filed July, 9, 1892.

Employs a variable resistance in series with the carbons and a yielding connection between the feeding mechanism and the resistance, whereby the latter is acted upon to compensate for variations of the resistance at the arc.

Measurement :—

Electric Meter. J. Perry, London, Eng., 486,123. Filed June 5, 1892.

Employs a rotary circular body, means for sending a current from its edge to its centre, or vice versa, and means for producing Foucault currents in the body.

Miscellaneous:—

Wire Covering Machine, J. A. Barrett, Brooklyn, N. Y., 486,270. Filed May 2, 1892.

Sign for Electric Lamps, E. W. Clay, Louisville, Ky., 486,324, Filed July 21, 1892.

Apparatus for Recording Speech or Other Sounds, W. Bruening, E. Orange, N. J., 486,394. Filed July 28, 1891.

Workman's Time Register, C. J. Garnett and A. Moore, 486,399. Filed Oct. 20, 1891. Keighley, Eng.

Metal Working :—

Electric Forge, G. D. Burton, Boston, and E. E. Angell, Somerville, Mass., 486,176. Filed Jan. 12, 1892.

Employs an electrode readily manipulated, adjustable and interchangeable to suit differently shaped bars, and easily removable when worn out.

Railways and Appliances :—

Electric Railway Conduit, A. W. Wright, Chicago, Ill., 486,315. Filed May 13, 1892.

Has for its object to provide a solid subway structure in which the yokes resist the pressure of traffic directly upon the pillars thereof, and in which the slot-rails are supported against deflection.

Trolley for Electric Railways, A. H. R. Guiley, South Easton, Pa., 486,333. Filed Dec. 31, 1891.

A conduit for street railways having outwardly opening hinged covers.

Switches and Cut-Outs :—

Double Snap-Switch, R. Lundell, New York, N. Y., 486,215. Filed Feb. 10, 1892.

Electric Switch, E. P. Warner, Chicago, Ill., 486,241. Filed Feb. 16, 1891.

Employs a shield of insulating material placed in front of the metallic parts of the switch and containing a slot through which the handle projects.

Telegraphs:—

Telegraph System, A. Gipperich, Richmond, Va., 486,332. Filed July 30, 1892.

Has for its object to permit all main-line circuits leading to a central station to pass through the signal and switch mechanism, which is set in motion by some propelling mechanism and is adapted to open and close in rotation each main-line circuit to connect and disconnect it with a single call instrument.

Telephones and Apparatus :—

Microphone, C. Clamond, Paris, France, 486,244. Filed Mar. 21, 1892.

Employs a working resistance composed of elastic material adhering to both electrodes. (See page 519, this issue.)

LITERATURE.

The Standard Electrical Dictionary. By T. O'Conor Sloane, Ph. D. New York, 1892. Norman W. Henley & Co., vi + 624 pages. Cloth, 5 x 7 inches. Price, $3.

The lexicographer who at the present time undertakes the work of collecting and correlating the electrical nomenclature is met by a serious problem, owing to the fact that in many cases the meaning of terms is, and has been for some time, in a state of transition; and, again, he is confronted by the fact that in order to bring his work within the compass of a handy sized volume, such condensation is required as must of necessity make the definitions appear in many cases not sufficiently broad to the critical examiner. The interesting work before us shows the effect of these conflicting points in a marked degree, inasmuch as the author has attempted that most difficult undertaking, the making of a popular work on a scientific subject.

In glancing over the book we frequently encounter the obstacles above referred to, due to the transitory state of the science. Thus, in the definition of the word "anode," without necessarily going back to Faraday's definition which locates the anode as the limiting surface of the electrolyte in contact with the positive plate, the author defines it "as the positive terminal in a broken metallic or true conducting circuit;" also as "the terminal connected to the carbon plate of a galvanic battery, or its equivalent in case of any other generator. In general practice it is restricted to the positive terminal in a decomposition or electrolytic cell, such as the nickel anode in a nickel-plating bath, or the anode of platinum in a gas voltameter. It is the terminal out of, or from which, the current is supposed to flow through the decomposition cell."

It will be noted that the author has defined the anode more particularly with respect to its function in the plating cell, and has, to our minds, left out the broader view of the function and nature of the anode in general, as applied in the primary cell. It will also be noted that he applies the word "terminal" in a manner which, we believe, is not generally supported by current usage, and which might be apt to lead the novice astray.

Turning to the term "cathode," on the other hand, we find it defined as "the terminal of an electric circuit whence an electrolyzing current passes from a solution. It is the terminal connected to the zinc plate of a primary battery." Here it will be noted the author has again restricted the definition to the electroplating cell, but in this case the second phrase is still more misleading than in the case of the anode.

We must also take exception to the general definition of the term "characteristic curve," which the author states is a "curve indicating the variations in E. M. F. during the rotations of the armature of a dynamo or other generator of E. M. F." Although more specifically explained later on, this statement in itself would hardly convey to the reader the broad, fundamental idea of the characteristic curve.

The author defines a "Voltaic or Galvanic Couple," as "the combination of two electrodes, and a liquid or liquids, the electrodes being emerged therein, and being acted on differentially by the liquid or liquids." Without laying too much stress on the narrowness of the word liquid, considering the gelatinous electrolytes and other forms of modern "dry" batteries, we hardly think that the differential action of the liquid or liquids can be called the true source of E. M. F. It is certainly not the case in the zinc-carbon cells, such as the Bunsen, in which the function of one of the liquids, the depolarizer, is the oxidation of the hydrogen formed on the carbon electrode. There is no *differential* action in this case.

In defining the electromagnetic theory of light, the author has, we think, fallen into an error due to the transposition of terms, by stating that "with few exceptions dielectrics or non-conductors are transparent." If he had put it the other way round, so as to read, that most transparent bodies are non-conductors, the statement would be more correct, and in keeping with the theory propounded.

Under the head of "Rotating Field," the author gives as an example the Mordey alternator, in which "the armature, nearly cylindrical, surrounds the field, and the latter rotates within it, the arrangement being nearly the exact reverse of the ordinary one." This definition does not to our mind cover Mr. Mordey's alternator, as built for the last few years.

Under the head of "Ions," the author has given another example of the chaotic state in which the whole question of "positive" and "negative," as applied to the voltaic cell, is in. Thus, he says that the ion "which appears at the anode, or *negative* electrode, is the anion;" while a few lines below in the same paragraph he states that, "the anion means the ion, which goes to the anode, or *positive* electrode." Surely it is time that this everlasting tangle be finally unraveled, and it would not be out of place to bring the matter to the attention of the Electrical Congress to be held in Chicago next year.

We have here merely drawn attention to some of the more important points, which seem to us to require comment, but we cannot help drawing attention to the fact that the work has suffered considerably from bad proof-reading. We have also noticed a somewhat curious fact that in not a few instances the illustrations given are of English apparatus. We do not mention this in any spirit of chauvinistic envy, but merely to remark that the author might with advantage have illustrated American apparatus, preferably, in more than one case.

The dictionary gives evidence of a large amount of painstaking work on the part of the author, and possesses features which must be commended. Thus, among these, we have noticed that the author, wherever occasion required it, has furnished the synonyms of terms, and the book is given an additional value by an alphabetical index, which enables it to be consulted for terms both collectively and individually. As it stands to-day, the work will prove of value to the reader whether professional or non-professional; but we are convinced, and we do not hesitate to say, that with a thorough revision, which the second edition will without doubt receive, it can be brought to a high state of accuracy. The definitions are, as a rule, put tersely and concisely, so that the inquiring reader can carry away a defined, net impression as to what is meant; while any student who will spend his leisure hours over the volume will be amply repaid for his time and trouble. The book is very clearly printed in bold type on good paper, and is well bound.

SOCIETY AND CLUB NOTES.

MEETING OF THE NEW YORK ELECTRICAL SOCIETY.

THE next meeting of this society will take place in Prof. Chandler's lecture-room, Columbia College, Forty-ninth street and Madison avenue, on Thursday, Dec. 1, at 8 p. m.

Prof. Edwin J. Houston, of Philadelphia, will deliver a lecture on the "Magnetic Field," which will be illustrated by lantern projections and experiments.

The following is a synopsis of Prof. Houston's lecture:

Definition of field. Group of curious properties possessed by the magnetic field. Early knowledge of the world respecting magnetic phenomena. Various facts concerning the attractive and other forces of the lodestone. Magnetic effluvia—Boyle's early conception of the magnetic field. Experimental study of some of the more important properties possessed by magnets. Various magnets. Faraday's conception of lines of magnetic force. Various methods on the graphic representation of the magnetic field. General principles of magnetism deduced from a study of magnetic fields. General phenomena of magnetic induction. The part which induction plays in the production of magnetic figures. Magnetic permeability and susceptibility. Coercive force and magnetic retentivity. The magnetic and electrical flux. Paramagnetism, and diamagnetism. Methods of magnetization. Discovery of Oersted. Theories and hypotheses of magnetism. Fluid theories. Ampere's theory. Hughes's theory. Ewing's theory. Phenomena of the earth's magnetism. Causes of the earth's magnetism.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

SECRETARY GEORGE F. PORTER announces that it has now been arranged to hold the sixteenth convention of the Association in the Bell Telephone Building, St. Louis, Mo., Feb. 28, March 1 and 2, 1893. Mr. Porter is now busy on preliminary work.

BROTHERHOOD OF ELECTRICAL WORKERS.

THE Brotherhood of Electrical Workers of America at Chicago have elected the following officers and adjourned: Henry Miller, grand State president, St. Louis, Mo.; P. F. Haley, first grand vice-president, Jersey City, N. J.; and J. I. Kelly, grand secretary-treasurer, St. Louis.

BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

A LECTURE on "Arcs and Arc Lighting" by Mr. Robert S. Dobbie, illustrated by apparatus, lantern photographs and experimental demonstrations, will be delivered on Friday, evening, Dec. 2, at 8 o'clock.

LETTERS TO THE EDITOR.

THE SPRAGUE-PRATT ELEVATOR.

WITH reference to Mr. William Rosenbaum's comments in your issue of November 16th, it is evident that the gentleman has had a very limited experience with electric motors, and especially as applied to elevator service. It would be well to remind him that with any well constructed machine, free from internal friction, where the duty required of the motor is measured by the work at the hoisting ropes, the motor cannot be stalled by any load which will be in practice put upon it.

It seems possible that Mr. Rosenbaum is the spokesman of someone else, and the purport of his comments would be more clear if he had so announced himself.

FRANK J. SPRAGUE.

NEW YORK, Nov. 26th, 1892.

LONG ELECTRIC ROADS.

IN the issue of November 9, of the ENGINEER, it was stated that the electric road between Baltimore and Washington was the largest project of the kind on foot at present. I understand that there is an electric road planned between Chicago and St. Louis, and work has already commenced on it in Illinois, which is expected to be finished in season for the benefit of World's Fair visitors. It is also claimed that a speed of 100 miles an hour will be attained.

I would like to ask if this is not something ahead of the Washington-Baltimore road?

J. WILSON BROWN.

BRIMFIELD, MASS., Nov. 22, 1892.

(Our statement was correct as far as it went. The difference between the two roads is that one is meant for through travel at a high rate of speed, and that the other is to be practically a street railway, running along a boulevard, and dropping passengers wherever they wish. Each is, therefore, we think, "the largest project of its kind."—EDS. E. E.)

PERSONAL.

MR. L. H. HART, who during the past year has had charge of the business of the W. J. Johnston Company, Ltd., has resigned his position and will hereafter have no connection with that concern. Associated with two or three other gentlemen well-known in trade journalism, he has bought out an old steam fitting paper in Boston, and will now publish it under the new auspices in this city, with the name *Heating and Ventilation.* It will be a handsome, well-edited monthly, and the first number issues early in January, with Frank W. Foster, president; H. M. Swetland, general manager and treasurer, and L. H. Hart, vice-president and secretary. Last week, Mr. Hart was given a luncheon by the staff of his old office, and was made the recipient of a beautiful little testimonial in the shape of a gold Odd Fellows' watch charm. Mr. Hart will now have a favorable opportunity to display his many excellent qualities, and in his new career he will start out with the hearty good wishes of a host of sympathizers and friends in the electrical field.

MR. EDWARD C. BOYNTON, M. E., recently of the Thomson-Houston Company, has been appointed electrician of the Lovell Manufacturing Company, Ltd., of Erie, Pa.

LEGAL NOTES.

TELEGRAM DELIVERY ON SUNDAY.

IN Georgia the telegraph companies will hereafter be exempt from penalties for failure to deliver messages on Sunday. The Supreme Court has decided that by Section 4579 of the Code it is made unlawful for any person (and this includes a telegraph company) to pursue his business or the work of his ordinary calling upon the Lord's day, works of necessity or charity only excepted. It follows that a telegraph company is not put by law, and cannot put itself by contract, under any duty to transmit and deliver messages on that day unless by reason of the subject matter of the messages in question that transmission and delivery can be fairly considered as a work of necessity or charity. A message from a son to his mother informing her that a particular person, a friend of the family, will arrive on a particular train, the object to apprise her that he, in company with the son, would be with her to take dinner, is not a message which can give to the work of transmitting and delivering it the character of either necessity or charity. A failure to perform the work on the Lord's day with reasonable dispatch will not subject the company to the statutory penalty, and an action therefor is not maintainable.

PATENT NOTES.

THE CANADIAN PATENT LAW.

SINCE the passage of the new Canadian patent act applications for patents have been rapidly increasing. Before the new act, inventors in this country were obliged to postpone applying for patents in Canada, until the United States patent was actually issued; otherwise the term of the latter would be but 15, instead of 17, years. Now, however, the inventor may file his applications in the United States and Canada at the same time, as the term in Canada has been changed from 15 years to 18 years. No models are required by the new act, except (as in the United States) that the Commissioner has the right to call for a model in particular cases.

All caveats expire upon issue of the United States patent for the same invention. For a period of one year after the grant, a United States inventor may import the patented article, to learn if his invention takes in Canada and to make arrangements to manufacture there.

FIRE UNDERWRITERS AND CENTRAL STATIONS.

A PAPER containing some 25 questions covering all the essential points in regard to the financial and material excellence of central stations, has been issued by Mr. George P. Low, electrical inspector of the Pacific Insurance Union, to every electric railway and lighting station within his jurisdiction, for the purpose of gathering authentic statistics and showing the falsity of the belief, still held by many underwriters, that a central station is an undesirable risk.

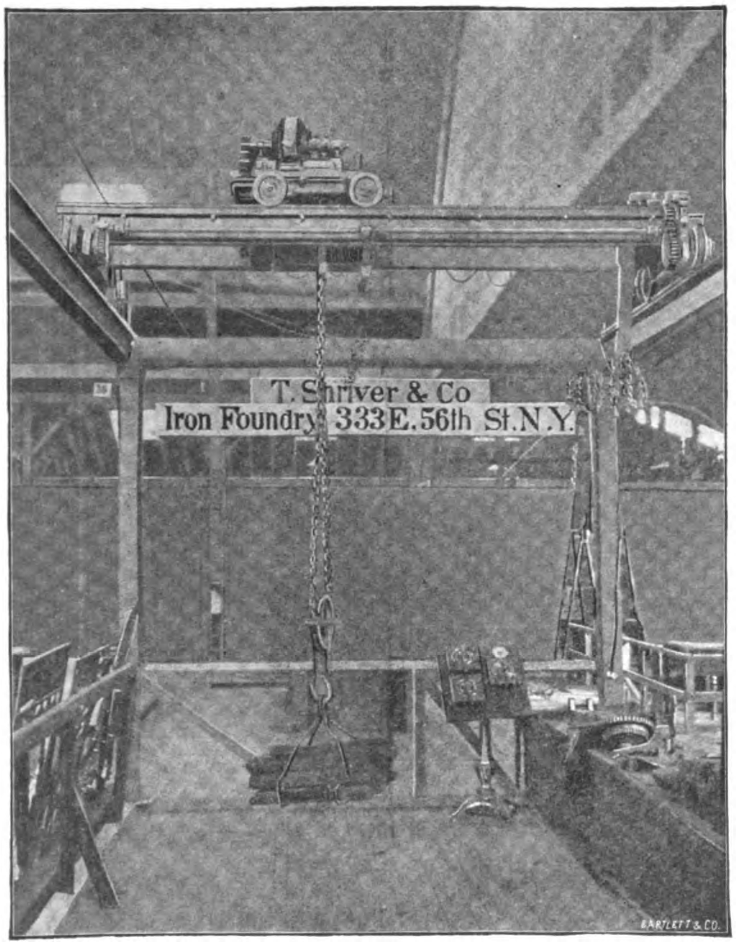
TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

Let your goods be known among all men.

T. SHRIVER & CO.'S NEW ELECTRIC CRANE.

In presenting to our readers this illustration and description of the Shriver crane, we shall deal with only one of the two classes of hoisting machinery. This is a device that not only raises or lowers its load, but shifts it as well horizontally at will. Friction is no doubt one of the greatest obstacles encountered in any load lifting device. No machine can be constructed to fully attain perfection, but there is no reason why it cannot be nearly accomplished. There are, however, a great many machines manufactured that do not nearly approach it, the cause being the undue friction of various parts. The contacts in the worm and worm wheel systems are sliding ones, and under the best possible condition, it is said, show a necessarily great loss by friction. In the crane here illustrated differential gears are used exclusively, thus avoiding much of the friction which, it is claimed, has hitherto counteracted their usefulness. In the manufacturing of the Shriver crane, together with the above good points, it may be said that the bridge carrying this crane is constructed of the very best steel beams, strongly framed. It is so constructed as to travel freely and square on the tracks on which it moves, no matter at what point on the bridge the load may be. In the construction of the Shriver crane, the motors of the C. & C. Electric Motor Co. are used. There are three motors for the equipment of each crane—that is, one motor for each movement—viz., 1st. The raising or lowering of the load; 2d. The movement of the motor carriage or crane upon the beams; and 3d. The moving of the entire device backward and forward on its elevated tracks. Each of the three motors or movements has its own controlling switch and reversing box. These can be operated singly or all at the same time.



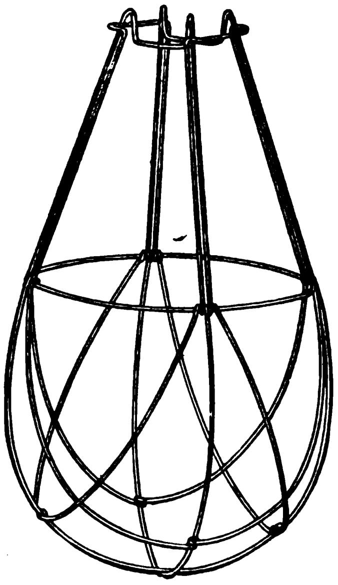
New Shriver Electric Crane.

This crane is made and sold by T. Shriver & Co., 333 East Fifty-sixth street, this city. The Shriver electric crane, as shown in the illustration, is on exhibition at the American Institute Fair, this city, where it may be seen in operation every afternoon and evening. This particular machine has been fitted with the motor wiring and controlling device of H. Ward Leonard & Co., 136 Liberty street, this city. The advantages to be derived from the use of this system are self-evident, when it is understood that by this system the operator has much more perfect control of the crane, besides the fact that there is an economy in power consumed, as only the exact amount of current required is generated, avoiding the use of large and expensive resistance boxes, which are, of course, a destructible and expensive part of an electrical outfit.

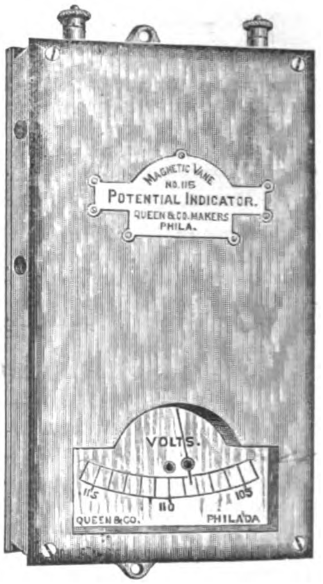
QUEEN'S POTENTIAL INDICATOR.

We illustrate herewith a new potential indicator which Queen & Co., of Philadelphia, are placing on the market. It is built upon the general plan of their "Magnetic Vane Voltmeter," and is mounted in a handsome mahogany case with open scale divisions, so that very close readings can be made. No permanent magnets or other parts which change with age are used in construction, so that constancy is assured. This is a very essential feature, as most instruments require frequent calibration—an item of considerable expense as well as annoyance. The indicators as kept in stock are adjusted for 110-volt circuits, but special ranges will be made to order. They are adopted for isolated plants and central stations. Queen & Co. are just issuing circular No. 395 which contains prices and full particulars.

Queen & Co. are now putting on the market the new ballistic galvanometer, concerning which an excellent article by Mr. E. G. Willyoung appeared in the Engineer of Nov. 16. They have issued a neat circular, No. 400, on the subject, implying that this completes their "four hundred" of elite instruments—subject, of course, to a revision of the rôle of honor from time to time.



Acme Expanding Wire Guard.



Queen's Potential Indicator.

THE ACME EXPANDING WIRE GUARD.

The "Acme Expanding Wire Guard" is the latest device on the market for the protection of incandescent lamps. It differs from others on the market in the fact that it requires no auxiliary clips or catches, but secures itself firmly on the socket in a way that is almost automatic. It has a very firm hold on the socket, having a bearing contact longitudinally on the shell of over half an inch, making it almost impossible to force it against the lamp with a blow. The guard itself is also made particularly strong and rigid. In appearance it is also a decided improvement, and is really handsomely symmetrical. The Acme guard is being placed on the market by the Electric Appliance Company, who are the manufacturers and sole agents. It is already having a large sale.

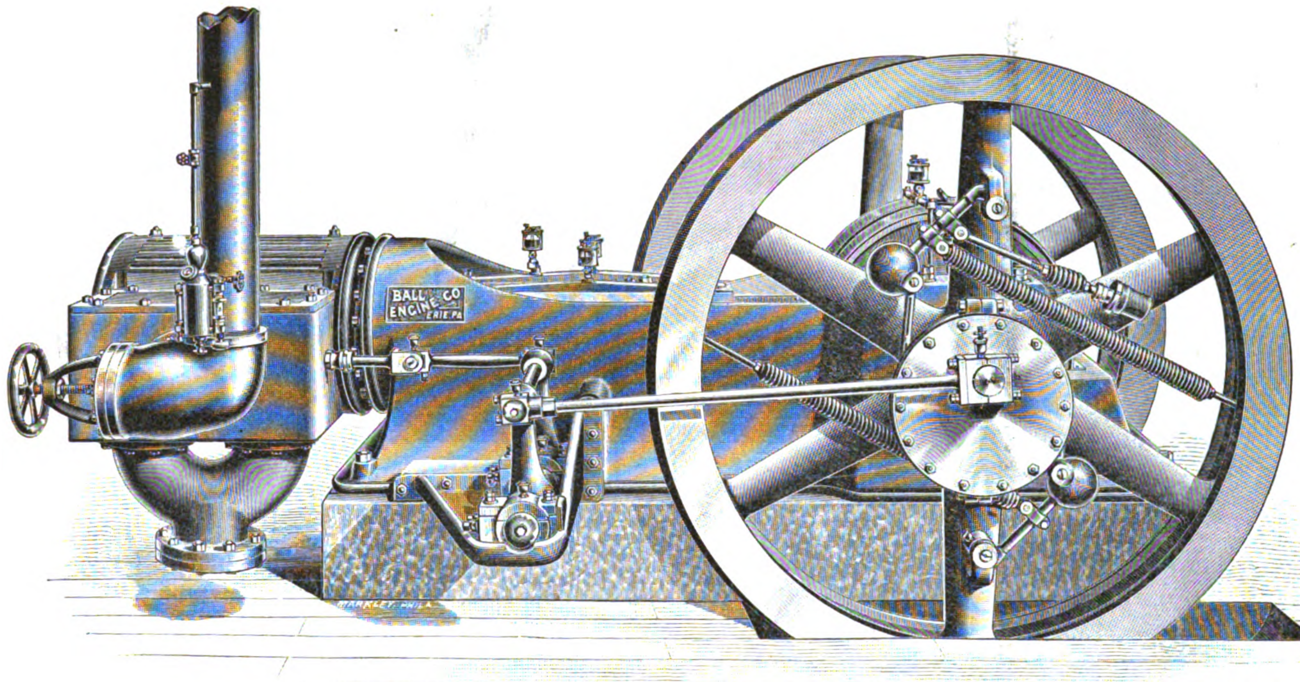
The Valentine Clark Company, dealers in poles and ties, have removed from their offices on the fifth floor of the Rookery Building to larger and more sumptuous quarters in suite 704–706, the Rookery. They needed more room to take care of their growing business properly.

NEW HEAVY DUTY BALL ELECTRIC RAILWAY ENGINE.

In selecting an engine for electric railway service, the character of its duties should be carefully considered. It will be found that the work is very exacting and severe, and the engine should be adapted for heavy duty, varying load, and long, continuous runs. It should, therefore, have great weight and strength, with sufficient metal so distributed as to receive the various strains and thrusts of moving parts without deflection or vibration. The engine shown in the illustration was designed by the Ball Engine Company, Erie, Pa., especially for electric railways and electric welding, and possesses the above requirements to an admirable degree, as may be seen from the cut, and the description following.

The frame of the engine is massive and heavy and internally ribbed so as to give the greatest attainable stiffness. The crank shaft is forged out of a solid steel ingot of the best quality, and is of large diameter and great strength. The connecting rod and straps are forged out of steel ingots and are of a new design, combining strength with efficiency. The main bearings are unusually large, and are so arranged that both the vertical and side wear of the liners may be taken up. The main bearing liners are genuine babbitt, carefully scraped and fitted, and as they are made removable, they can be quickly and easily taken out and replaced with new ones if necessary. The crank pin boxes are lined with genuine babbitt. The crosshead boxes are made of pure copper and tin. The crosshead is a steel casting with very large bearing surfaces and is babbitted on the four faces with genuine babbitt. The crosshead pin is tool steel, and the piston rod a fine quality of crucible steel. The oiling devices are of the most improved form, and all fittings are complete and of the best description. The regulation by means of the improved governor is such that the engine has shown in practice perfect regulation under conditions where the variation in load on the generator from zero to the full capacity has occurred in less than five seconds.

Without going into any further details, it will suffice to say that thorough workmanship and materials of the highest excellence go into the construction of the engine, and every detail receives the most careful attention. The manufacturers, the Ball Engine Company, Erie, Pa., believing that the electric street railway interests require a strictly first-class engine in every respect, have designed the engine to that end, and have, they think, succeeded.


BALL ENGINE CO ERIE PA

NEW HEAVY DUTY BALL ELECTRIC RAILWAY ENGINE.

The Kester Electric Company, of Terre Haute, Ind., report the following sales of direct current apparatus since November 12: Standard Wheel Company, Fort Wayne, Ind., 300-light dynamo; Louis Snider's Sons Co., Hamilton, Ohio, 200-light dynamo; John Ruby, Louisville, Ky., 7½ h. p. motor; Blair & Failey, Terre Haute, 50-light dynamo.

LARGE SALES OF KESTER DYNAMOS AND MOTORS.

The Kester Electric Company, of Terre Haute, Ind., report the following sales at the end of October: 30-light dynamo, Zimmerman & Stahl, Terre Haute, Ind.; 50-light dynamo, Jones & Hill Co., Elkhart, Ind.; 50-light dynamo, Kelley Bros., Goshen, Ind.; 50-light dynamo, D. W. Williamson & Co., Indianapolis, Ind.: 3 h. p. motor, Moore & Langen, Terre Haute, Ind.; 2 h. p. motor, Cooper Manufacturing Co., Saint Joseph, Mich.: 2 h. p. motor, Lincoln Electric Railway Co., Lincoln, Ill.; 5 h. p. motor, Heat, Light and Power Co., Muncie, Ind,; 1 h. p. motor, Van Nort Bros., St. Louis, Mo.; 7½ h. p. motor, Decatur Gas, Light and Coke Co., Decatur, Ill.; 10 h. p. motor, A. H. Crawley & Co., Peoria, Ill.

THE F. P. LITTLE ELECTRICAL CONSTRUCTION AND SUPPLY COMPANY.

A new concern with the above title has just been incorporated at Buffalo under the law of the State of New York. The directors are S. F. Eagan, Peter P. Miller, F. P. Little, John L. Williams and C. R. Huntley, and at the election of officers the following were chosen: John L. Williams, president; Peter P. Miller, treasurer, and F. P. Little, secretary. The capital stock is $100,000 with a provision in the incorporation papers for increasing to $250,000 whenever desired. One-half the capital is already paid in, and the incorporation is complete in every detail. The old firm of F. P. Little & Co. will go out of business on January 1, having made a very clean and brilliant record in the field of electrical construction. The new company, whose incorporation is due to the success of the old firm, will have even larger opportunities of usefulness and profit, and under Mr. Little's skillful guidance may be depended upon to make the most of them.

LA ROCHE ELECTRIC WORKS.

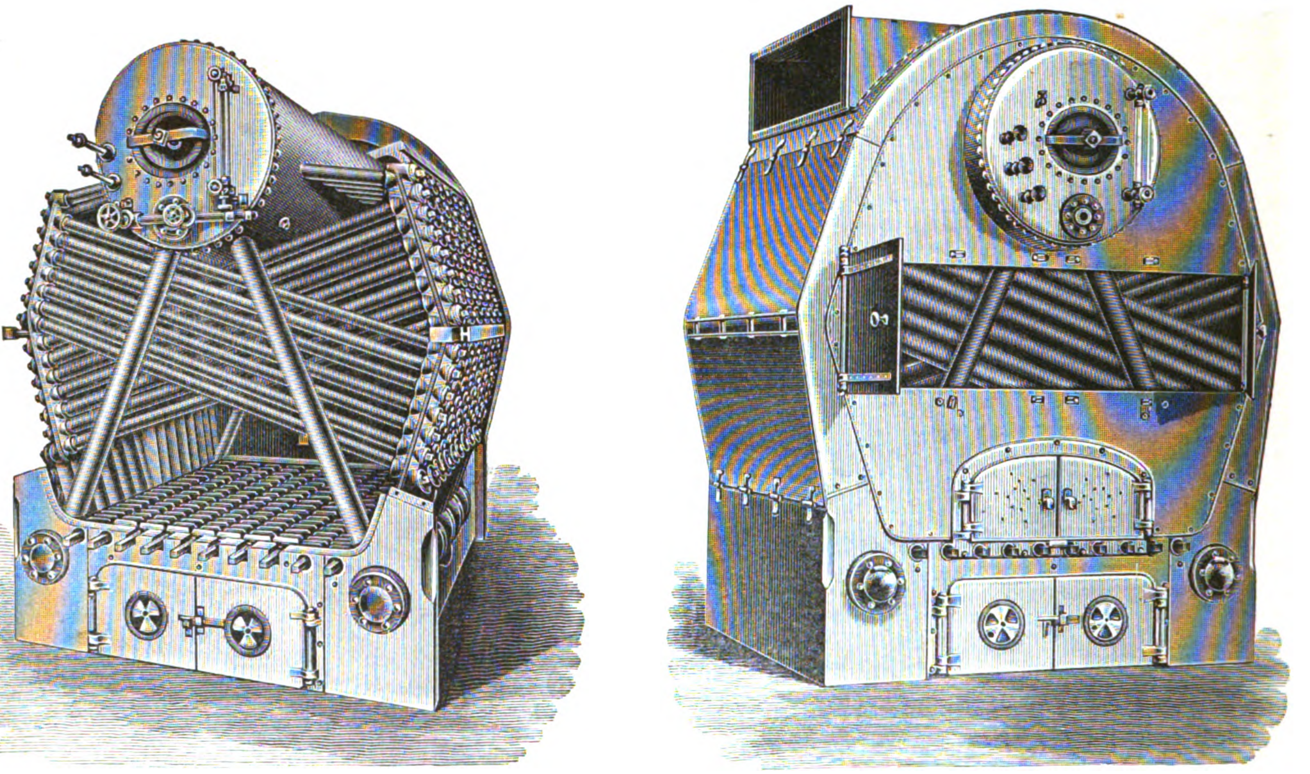
The above works of 116–118 North Sixth street, Philadelphia, write us to correct a statement made in a contemporary as to the wiring of the Winter Circus. They state that it is they who are doing the wiring at the new place of amusement, and that they are putting in the entire installation, which promises to be, as usual, a fine piece of work. The mistatement probably arose from the fact that the La Roche Works employed another concern to wire up for a few extra lamps, which the Works were too busy to put in themselves at the moment.

Mr. Avery P. Eckert, who has become widely known in connection with Kerite, has transferred his field of usefulness to the South. He has just returned from an extended trip, in which he visited all the Southern States and secured a number of good orders for the famous Kerite wires and Kerite elastic tape.

THE NEW YORK SAFETY SECTIONAL WATER TUBE BOILER.

The accompanying illustrations show a sectional boiler manufactured by the New York Safety Steam Power Co. of 30 Cortlandt street, this city, designed to be economical of valuable space, and at the same time to be of liberal proportions in grate area and heating surface. The interior is readily accessible from the outside, for examination, cleaning or repair. The furnace extends under the entire boiler, and is of proper height to permit the use of any kind of fuel. As will be seen upon reference to Fig. 1, the tubes are arranged in transversely-inclined series of several tubes per section, and are all straight. Each tube is lap welded, and expanded at the ends, and is wholly in the furnace directly over the fire. The proportion and combination of parts throughout the boiler is such that expansion and contraction, due to changing temperatures, can occur without straining, and, the tubes being short, tubular expansion is greatly reduced.

These boilers are proportioned and rated for generating power on the basis of the Centennial standard—namely: "The evaporation of 30 pounds of water, at 70 lbs. pressure, from temperature of 100° to be 1 h. p. Said duty to be accomplished with a consumption of anthracite coal of good quality, at rate of twelve pounds per hour per square foot of grate with good natural draft."



Figs. 1 and 2.—New York Safety Sectional Water Tube Boiler.

The actual steaming efficiency, and also the ultimate capacity, is largely in excess of this rating. In this boiler, each section of tubes and headers is tested under 500 lbs. hydrostatic pressure. The main steam drum is made of open-hearth homogeneous flange steel plate, having a tensile strength of not less than 60,000 lbs. per square inch of sectional area, and possessing sufficient homogeneousness, toughness and ductility, to show a contraction of area not less than fifty per cent. while the plate employed is of proper thickness to enable the boiler (under government standard of pressure allowable) to carry a working pressure of 250 pounds per square inch. The water circulation is natural and positive. It is passed through the tubes and exposed to the action of the fire in a steady and continuous flow. The steam generated is quickly conducted to the drum, and in consequence of the ample disengaging surface provided, separates from the water without turbulence, and becomes dry steam ready for use.

The system of cross-tubes employed in this boiler results in the concentration of heating surface to a remarkable degree, yet it does not contract the area of grate. Hence the capacity of the boiler in horse power per cubic foot of space occupied is very great. By reason of its sectional character, this boiler can be delivered in places wholly inaccessible to many other desirable boilers. A boiler of 200 h. p. can be passed through a 4 feet by 4 feet doorway, window, or sidewalk opening. A boiler of 100 h. p. occupies a floor space 7½ feet square, and is less than 10 feet high.

Fig. 2 shows the boiler with the casing doors open affording access to the tubes.

KEYSTONE ELECTRIC WORKS.

As an evidence that advertising in The Electrical Engineer pays, the Keystone Electric Works, of Erie, Pa., as a result of their advertising, have recently shipped to Valparaiso, one of their 40-light dynamos—the order having come through Messrs. Hickox & Reed, of Chicago. Verily, The Electrical Engineer "thoroughly covers the electrical field."

ELECTRICAL SUPPLY COMPANY.

The motor department of the Electrical Supply Company, Chicago, which was recently added, has each month shown an increase in the amount of business done and so important has that department become, that Mr. F. S. Terry, manager of the Supply Company recently visited the factory of the Crocker-Wheeler Company, whose motors are handled exclusively, with a view of learning something in reference to their manufacture, and he was greatly interested in the care taken in every part. Mr. Terry feels confident that with motors of such superior quality, this department of the Supply Company's business will continue to increase until in a year or two, it may be the most important branch of their trade.

At the Cleveland meeting of the American Street Railway Association, a little brochure, issued by the Electrical Supply Co. was circulated among the members. It consists of about 30 leaves of heavy plate paper tied together, each bearing a beautifully executed engraving of some piece of street railway apparatus. A cleverly worded dedication to the association, and a list of its first officers elected in 1882 complete a very tasteful souveinr.

AUBURN ELECTRIC MOTOR COMPANY.

The Auburn Electric Motor Company, of Auburn, Me., is a new concern, which appears to be meeting with much success in building dynamos and motors. It has not been able to keep up with its orders, and expects to be obliged to enlarge its facilities very soon. It has just put in a 100-light dynamo in the Fitz Brothers' Last Company's new shop, and the plant is working finely. It is also building a 100-lighter for the Jordan & Frost planing mill at Lewiston. These dynamos are the design of Mr. W. F. Brown, the electrician of the company.

THOMPSON & PINOLET.

Messrs. Edward P. Thompson of this city, and Louis M. Pinolet, of Montreal, have entered into a copartnership under the firm name of Thompson & Pinolet, patent solicitors, with offices at 5 Beekman street, New York city and 1401 Dorchester street, Montreal, Canada. They report a great increase of Canadian business since the passage of the new patent act.

WESTERN NOTES.

THE CHICAGO EDISON COMPANY will erect immediately a large plant to furnish light and power on the North side, and the work has already been begun. The new power house is to be located on the Newbury Library grounds in the rear of the Library Building on Oak St., between Dearborn avenue and Clark St. This power house will be of large dimensions, giving room for growth, and starting off with about 1,000 h. p. capacity. Numerous requests have been received by the Edison Company from residence owners in that section of the city for current. The machinery, boilers, engines, motors and underground conductors have been ordered, and work of wiring residences and stores will commence at once, and the whole plant will be completed and running about May 1st. The improvements are to cost half a million and the lights are to be extended as rapidly as demanded. The area to be supplied at once will extend from the north limit of Lincoln Park to Ohio street on the south and from Wells street to the lake. The large plant now being built at Harrison street and the river is being pushed along rapidly. When this plant is finished, the north side power house will be used as a substation, drawing on the main station for an extra supply when required. Next year the west side will be equipped with the system. The station at Harrison street and the river is to be a capacity of 35,000 h. p. Some exceedingly large feeders have been laid, connecting the present Edison station on Adams street with the new one in process of construction on Harrison street; the positive and negative feeders are of 1,800,000 c. m. capacity and the neutral of 900,000. Special arrangements have also been made by means of switches to use a portion of the neutral copper on the outside conductors if required, and also for cutting in and out the sections of the feeders according to the load.

THE CENTRAL ELECTRIC COMPANY report the heaviest sales for Okonite wire in the month of October that they have ever experienced. The demand for high class goods seems to be daily increasing, as consumers are waking up to the fact that permanency is the essential point in electrical construction. The Washington carbons are finding a ready sale, several of the largest companies throughout the country having contracted with the Central Electric Company for all the carbons they use. They report having several handsome orders for large construction jobs, and feel convinced that the next two months will be very busy ones.

THE LINDELL ELECTRIC LINE, at St. Louis, suffered last week a heavy loss by fire, which broke out in the car house. The burned structure is a large building of brick and stone in the shape of an oblong. An attempt was made to roll some of the motors out in the street away from the fire, but their great weight prevented these efforts from being successful. It was found impossible to save the building or its contents on account of the fierceness of the fire, but it was prevented from reaching other buildings. The loss, estimated at $150,000, was fully covered by insurance.

THE KNAPP ELECTRICAL WORKS have recently closed a very large contract for Safety wire in Cleveland, Ohio. This brand of wire is receiving well-merited attention, and the trade in it is increasing. The Knapp Electrical Works of Chicago have been appointed exclusive general western distributing agents for the Ries regulating sockets for the States of Illinois, Indiana, Ohio, Michigan, Iowa, Wisconsin, Minnesota, Missouri and Colorado. The Ries socket enables the consumer to burn his lamps at any desired degree of brilliancy.

THE CROWLEY ELECTRIC CO. has been organized with offices and headquarters at 18 West Superior street, Duluth, Minn. The new company will deal in all kinds of electrical supplies, do all kinds of electrical work and handle an extensive and comprehensive line of combination and electric fixtures. The gentlemen connected with it are well-known in the electrical circles of the Northwest and have installed a large amount of electrical work. They guarantee to treat everyone right who has any dealings with them.

THE POCKET TELEPHONE DIRECTORY of Chicago's electrical people and engineers, etc., issued by Mr. Chas. E. Gregory, the dynamo and motor dealer of that city, has received the hearty appreciation of all those who have been fortunate enough to receive one. It is in the form of a small note book for the vest pocket with ample blank sheets for voluminous note taking. The idea is somewhat of a novel one and highly creditable to Mr. Gregory's genius in little matters of this kind.

THE ELECTRICAL SUPPLY COMPANY have issued two engravings representing the interior of a street car "before and after using" the Carpenter heaters. These heaters are being actively pushed, now that cold weather has come, and the company anticipate large sales.

MR. THOS. G. GRIER, agent for the Bryant Electric Company, whose offices are in the Monadnock Building, Chicago, is enjoying a constant and steady demand for their switches and sockets.

MR. H. L. PARKER, the president of the Emerson Electric Manufacturing Company, of St. Louis, Mo., manufacturers of electric lighting and railway specialties and alternating current motors, spent several days in Chicago recently. Mr. Parker states that he has still got his elephant on his hands, but he didn't bring him to town with him, as all the readers of the ENGINEER are familiar with him from seeing his portraint therein, and they are not anxious to "see the elephant."

THE ELECTRIC APPLIANCE COMPANY have been engaged for the past few weeks in rearranging and enlarging their store and office to make room for the larger working force necessary to take care of their rapidly increasing business. The demand for their numerous specialties is rapidly on the increase. The call for their new Acme wire guards has been so heavy that the factory has been swamped with orders, and they are making arrangements to largely increase their facilities.

MR. GEO. CUTTER, 329 Rookery Building, Chicago, is, as usual, hard at work filling orders for his famous specialties. He always seems to have just the little articles that the central station man needs. He has always made a particular study of designing and handling the choicest kinds of specialties, and his name has become a household word from his ingenious method of advertising and the quality of his goods among the stations all over the country.

MR. WILLIAM PATTON, inventor of the Patton motor system, has just returned from Louisville, where he has been starting up the first consignment of cars built for that city. The car in operation there does its work very successfully, and everyone, from the officials of the road down, were delighted with it. The street railway connecting Pullman with the Chicago street railway and the World's Fair will be equipped with this system.

MR. A. H. ENGLUND, secretary and treasurer of the International Register Company, 300-302 Dearborn street, Chicago, is much pleased with the way orders are coming in for the fare register for street railways manufactured by them. It meets with general satisfaction from users, and their repeat orders are numerous. It is exceedingly neat and compact, and the workmanship throughout is of the best.

THE MASSACHUSETTS ELECTRICAL ENGINEERING COMPANY, through Mr. Phillip Harvey, manager of their Chicago office, room 201, First National Bank Building, are just preparing complete plans and specifications for the entire lighting of Oconto, Wis., and the vicinity. Any inquiries from firms desiring to bid on electrical machinery should be addressed to Mr. Harvey in Chicago.

MR. M. B. AUSTIN, who was for some six years associated with the Western Electric Company, and who allied himself with the Knapp Electrical Works last October, is securing a large amount of business for his company, and looks hale and hearty in the midst of prosperity. Mr. Austin is a pushing, energetic salesman and never fails to capture a nice order when it is in the field.

THE ENTERPRISE ELECTRIC COMPANY, 313 to 315 Dearborn street, Chicago, report the recent shipment to them from the National India Rubber Company's factory at Bristol, R. I., of two car loads of all sizes of their wire and cables, to fill orders and make an attempt at stocking up. The demand for these excellent wires was never larger.

MR. COOKE, the Chicago agent of the Buckeye Electric Company, reports a flourishing demand for Buckeye lamps. They have recently brought out a new double-looped filament lamp, which gives a very beautiful diffusion of the light and is exceedingly attractive.

THE PIONEER ARMATURE WORKS are receiving numerous consignments of burned-out armatures to undergo their healing treatment. They make a specialty of this work and guarantee all rewinding to be first-class in every respect.

MR. J. F. MACARTNEY, traveling salesman of the Railway Equipment Co., Pullman Building, Chicago, has returned from an extended trip and is spending a day or two here.

MR. F. S. TERRY, manager of the Electrical Supply Company, of Chicago, has gone East to eat Thanksgiving dinner in his paternal halls, and will be absent for about a week.

G. E. HORN & CO., 63 South Canal street, are receiving a great many orders for their bells, for which they make many strong claims, among others, durability and cheapness.

THE ILLINOIS ELECTRIC LAMP CO. say that business is very good with them and Jewel lamps which they manufacture are giving very general satisfaction.

W. C. LYMAN, 49 Michigan street, reports business as very lively in exhaust heads and orders are coming in briskly all the while.

THE POND ENGINEERING CO.

The Pond Engineering Co., of St. Louis, Chicago and Kansas City, announce that they are prepared to furnish any style of pump valve adapted to the standard makes of pumps, and to withstand the action of any liquid. They make a specialty of hard and soft rubber valves, usudurian valves, Jenkin's valves, naphtha valves, comb rubber valves, metallic valves, etc., and carry a very large stock. Among their other specialties may be mentioned the Hoppes live steam feed water purifier, for preventing scale, made in sizes from 50 to 1000 h. p., the Blake steam pumps, and the Sheffield grate bar, which is claimed to give 50 per cent. air space and to be proof against burning or warping. The standard slide valve engines and the boilers manufactured and sold by this company are too well known to require description.

A neat little 16-page pamphlet, entitled "How to Obtain Dry Steam," is the Pond Engineering Co.'s latest addition to the literature of mechanics, and contains engravings and subject matter relating to the Pond separator, together with a partial list of users containing the names of 36 well-known companies, institutions and individuals.

THE NEW ENGLAND ENGINEERING COMPANY.

Mr A. M. Young, of Waterbury, Conn., and his friends, have purchased the New Britain Electric Light Company and the New Britain Tramway Company, and intend to build a new and modern power station for the supply of electricity for light and power. They have already begun the work of relaying the track, and will equip the road electrically within the next two months. They propose to make it a first-class plant, embodying all the latest advances in the art.

Mr. Young and associated capitalists have also bought the Palmer and Monson Electric Light Companies, and have purchased a very large water-power lying between the two towns, at Blanchardville. They will put in a combination water and steam plant to light both Palmer and Monson and to supply power to the heavy manufacturing concerns that are situated in that region. Another purchase is that of the Rockville Gas and Electric Company. A similar increase of capacity will be made, for gas and electricity alike, and it is proposed to secure, if possible, legislation which will enable the building of several miles of electric railway.

NEW FACTORY FOR THE CARD ELECTRIC MOTOR AND DYNAMO CO.

Owing to the rapid extension of their business, the Card Electric Motor & Dynamo Company, of Cincinnati, have secured possession of one of the most eligible factory sites in that city. It is the southeast corner of Hunt street and Broadway, where they propose to erect at once a large new factory for themselves. The building is to have a frontage of 175 feet on Hunt street and a depth of 86 feet. The whole of this space will be covered with a three-story building, the plans of which are now receiving the architect's finishing touches. It is hoped to begin the building in December, to push the work to the utmost, and, with favorable weather, to enjoy occupancy of the new quarters not later than the first of February.

NEW YORK NOTES.

Mr. Frederick Saxelby, until recently in the selling department of The General Electric Co., with headquarters at Philadelphia, has resigned and accepted a similar position on the staff of Mr. Charles D. Shane, No. 136 Liberty street, New York. In his new capacity Mr. Saxelby will handle the Weston instruments, the Carpenter enamel rheostats, the Sunbeam incandescent lamps, and the manufactures in general of the Siemens & Halske Electric Co. The large experience which Mr. Saxelby has gained during his ten years' active work in the Edison lamp works will make him a welcome visitor in many electric light stations, and we have no doubt that Mr. Saxelby's many central station friends will, as heretofore, welcome him in his new capacity.

Wright Universal Electric Company.—At a recent meeting of the officers and directors of the Wright Universal Electric Company Dr. Robert Taylor was appointed a director and was as well made secretary of the company. The Doctor has been very successful in introducing the many specialties of this company, and some very nice orders have been booked at the American Institute Fair, where a splendid exhibit of bicycle lamps, postmen's and conductor's lamps is shown. Dr. Taylor devotes a considerable time each day at the fair interesting the many visitors to the exhibit.

W. R. Brixey, manufacturer of the famous Kerite insulated wires and cables, is adding to his already large factory two large additions. One 120 x 48 feet and one 60 x 45 feet. Also is putting in a new Abendroth & Root water tube boiler of 155 h. p., a Green horizontal engine of 125 h. p., and has just had erected a 400 Edison electric light plant.

Mr. J. E. Ham, has been appointed general agent of Day's kerite, at the New York offices, 203 Broadway, where he will have full charge of Mr. Brixey's interests. Mr. Ham is entitled to warm congratulations upon his promotion, which he has won by years of faithful and intelligent work in looking after the books and correspondence of the concern at this end of the line. Mr. Brixey will continue to alternate between New York and the factory at Seymour, Conn.

The Brush Electric Company have just completed the installation of a 30 arc light plant at the factory of Benedict & Burnham, Waterbury, Conn., and a 60,000 watt Brush alternating plant at Cornwall-on-Hudson, N. Y., both of which plants were recently sold by Mr. A. D. Dorman, of the New York office of the Brush Company.

The Short Electric Railway Co. have removed from their offices in the Mills Building, and are now gathered under the wing of "the old lady of Broad street," their present offices now being established at No. 44, where the General Electric Company broods, with a sub-company beneath each feather.

Mr. James B. McCreary, Brown's Building, Buffalo, N. Y., has taken the representation of the National Electric Manufacturing Company in New York State west of Syracuse.

NEW ENGLAND NOTES.

The Lobdell Car Wheel Co., of Wilmington, Del., have placed the contract for their new machine shop with the Berlin Iron Bridge Co., of East Berlin, Conn. The building will be 67 feet in width, divided into a central portion, 25 feet in width, with a wing on each side 21 feet in width. The central portion is controlled by a 15-ton traveling crane. The building will be 151 feet long, the entire framework being of iron, the side walls being of brick.

The Whitney Instrument has already won its way into favor, and the Electric Appliance Company are receiving daily orders from customers who have given the instrument a careful test and are well pleased with its operation. Their new Acme expanding wire guard is also meeting with a large sale and will undoubtedly be generally used in the course of only a short time.

The Massachusetts Chemical Company, No. 8 Oliver street, Boston, C. A. Baldwin, president, report that their sales of Insullac are increasing very rapidly, and that they are selling to the largest electrical companies in the country. They are vigorously urging its claims as the best insulating compound yet discovered.

PHILADELPHIA NOTES.

Harry S. Smith & Co., Ltd., are having their store stocked with one of the finest lines of electrical supplies that can be found in the East. The company has already closed several nice contracts, among which is one for wiring and lighting the Hotel Metropole for 1,500 lights, and has placed three direct coupled ventilating sets which will be arranged to run on three speeds. Instead of the usual annunciator they will use the Herzog Teleseme system, the first one in the city. Brass covered Interior Conduit will be used throughout.

The National Electric Company are wiring the Philadelphia College of Pharmacy, the residence of C. W. Bergner and many other smaller buildings. Mr. Warrell says business was never better than now.

The Pelton Water Wheel Company, of San Francisco, has several important contracts in hand for electric power transmission stations in the West, among which may be mentioned the Standard Consolidated Mining Co.—a plant of 250 h. p. capacity—the power from which is to be transmitted a distance of 13 miles to the mills of the Company, located at Bodie, Cal.; the People's Electric Power Company, at Aspen, Colorado—a 750 h. p. plant designed as a central distributing station for general mining use, involving a transmission of about three miles; and the Walla Walla Electric Light and Power Company, at Walla Walla Wash.—a 400 h. p. plant intended for light and power purposes—from which a street railroad is to be run; also a new 1,200 h. p. plant for the Roaring Fork Electric Light and Power Co., at Aspen, Colorado.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.
VOL. XIV. DECEMBER 7, 1892. No. 240.

THE BURKE CABLE RELAY AND TRANSMITTER.

THERE is probably no department of electrical work which has so nearly adhered to the original practice as that of cable telegraphy. Although it would be untrue to say that no valuable refinements had been introduced since the laying of the first cable, we can not recall a single radical departure from the original methods. This remark applies particularly to the working of long cables. More especially in the development of the cable relay and in automatic transmission, such as we find on land lines, has cable telegraphy remained almost stationary. When we consider the increased transmitting capacity which automatic transmission would allow of and the reduced time and cost of operation from substituting a relay for the hand re-transmission between land lines and cable and *vice versa*, now in vogue, it is not to be wondered at that earnest efforts have frequently been made to bring about a change in this respect.

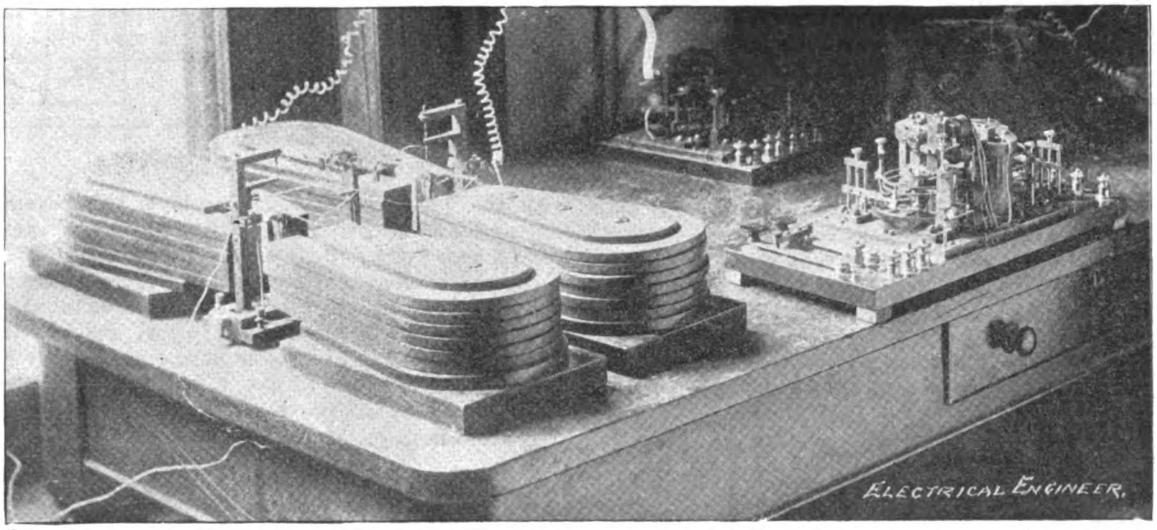


FIG. 1—BURKE CABLE RELAY AND TRANSMITTER.

Among those who have devoted their attention to this problem is Mr. Charles G. Burke, of this city, some of whose recent work is embodied in the apparatus we are about to describe. Mr. Burke has started out with the object of effecting cable transmission by means of the well known and simple Morse system, modified only in so far as to adapt it to cable working. His instruments consist of a novel relay and transmitter which are shown in the engraving, Fig. 1. The results obtained by him are well shown in Fig. 2, which is a fac-simile reproduction of the record made with the relay over the Direct United States Cable between Ballinskelligs, Ireland, and Halifax, Nova Scotia, the length of the cable being 2,640 knots.

The Burke relay by which the Morse record just referred to was made comprises two sets of coils, or what may be termed two compound coils, suspended in two independent fields of force created by four compound permanent magnets and a local circuit controlled by the movements of both sets of coils acting in unison. The arrangement is shown diagrammatically in Fig. 3. The coils constituting these compound coils E and F are set at angles to each other, so as to present in each compound four sides or poles. The angles of the coils and the inner lines of the poles of the field magnets, shown in the engraving, Fig. 1, are normally arranged to present such electric and magnetic relations to each other as that when the coils are energized by an electrical impulse, a rotary motion will be communicated to the coils around the line of their suspension and in a direction dependent upon the direction of the current. Like poles of the compound horse-shoe magnets illustrated are presented to each other. All the coils are connected in series so that the whole current is directed through each coil. The windings of the coils are so disposed as to produce a simultaneousness of co-operative action in the same direction.

Midway between the coils E and F is placed a standard C supporting two horizontal arms, L'', L'' through which is delicately pivoted a spindle L, bearing a contact arm L. The contact arm L is free to turn on its supporting spindle, but its motion is limited by an adjustable contact point or stop a and an insulated stop b. The extent of the motion or play of the contact arm L is designedly made as small as possible, and the tendency in one direction or the other of arm L is regulated by the adjustable springs N N. The arm M and stop a are terminals of a local battery R and this battery operates the sounder P, or other receiving or repeating instrument.

The coils E and F respectively support a rigidly affixed arm or bar of aluminum made as light as practicable and to ends of these aluminum bars J and J' are attached the silk threads K and K' extending on both sides from one bar to the other. The spindle L' of the local circuit standard C carries a similar aluminum bar or arm J'' and the silk threads K and K′ are made to pass beneath the ends of this bar J″ and are in frictional contact therewith.

By the adjusting screws A′ A′ the standards B and D, from which the coils are suspended, may be made to approach or recede from each other and the tension of the silk threads and the extent of their friction against arm J″ thereby be regulated. The contact arm L is free to revolve on its supporting spindle L′ by its adaptation to the fine screw thread cut on the spindle; a rubbing contact ensues from this motion and tends to prevent sticking at the local contact point. This freedom of motion of arm L contributes also to the more perfect freedom of the coils.

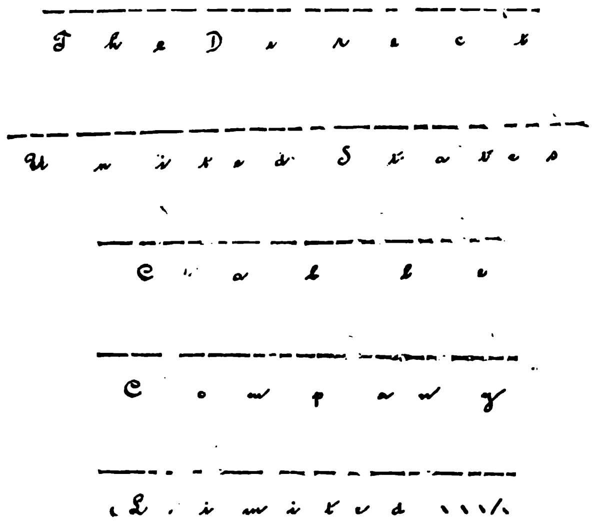


FIG. 2.

It will be noted that the coils of this relay are disposed where the field intensity of the magnets must exercise the greatest power, and that the coils are free to move in either direction and to the extreme limit to which a given direction of current can turn them. They are therefore able to follow the fluctuations of potential which always more or less attend all signals on cables, and to communicate all of these fluctuations to the contact arm of the local circuit and thereby reproduce on the receiving instrument the signals which caused them.

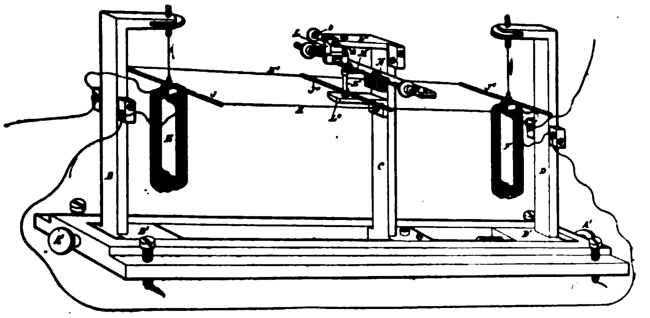


FIG. 3.

Recognizing the difficulties which grow out of any undue prolongation of battery contact in long cables, such as are, for instance, necessary under ordinary circumstances in making Morse dashes, Mr. Burke has devised a transmitter which comes in between the operator's key and the cable and which regulates the duration of battery contact with the line entirely independently of the operator. By this transmitter the static charge of the cable is made an auxiliary instead of an obstruction in Morse cable work.

The transmitter which is shown beside the relay on the table in Fig. 1, consists of a transmitting wheel or revolving contact maker mounted on the spindle B, Fig. 4; on the outer face of this contact making wheel and at regular distances thereon are cut angular shaped contacts E D, one side of each of these angular contacts being a right line. In direction of this right line of the angular shaped contacts two levers or contact brushes F and G are arranged and set so as to impinge upon the surface of angular contacts when the contact wheel revolves. These contact brushes are the terminals of the main batteries, as shown in the diagram Fig. 5, and control opposite polarities. They are independently adjustable upwards and downwards along the right line of the angular contacts so that they may be made to pass over a wider or narrower part of the contact surfaces and thereby increase or diminish the extent of battery contact with the line as the occasion may demand.

The contact wheel is normally held at rest by means of an escapement. The escapement pins J K in connection with the locking and releasing lever H″ prevent the contact wheel from revolving until the operator's key H′ energizes magnet G, by the power of local battery G″. One set of the escapement pins are insulated from the contact wheel which is in line, and the other set put the line to earth through lever H″ whenever the contact wheel reaches its normal position of rest, which is at the end of every completed signal. The function of key H′ is to release the contact wheel whenever the key is closed, and this key is operated as is usual in ordinary Morse work.

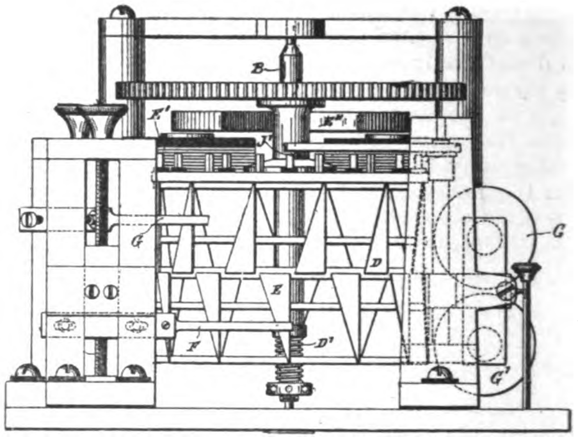


FIG. 4.

When lever H″ is released from the escapement pin with which it is engaged, the transmitting wheel advances one step and carries its contact surface under and beyond the battery controlling lever and thereby an impulse is sent into the line. As soon as this impulse has been completed, lever H engages an insulated pin on the transmitting wheel

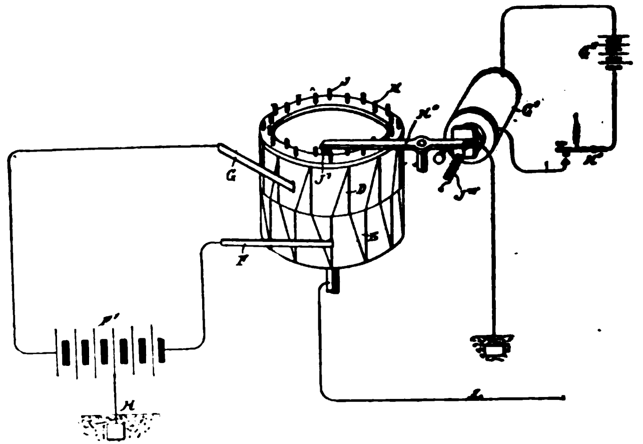


FIG. 5.

and arrests the wheel. The line at this point is insulated from both battery and earth and so remains until the operator opens his key and permits retracting spring J″ to release lever H″. As lever H″ becomes released the contact wheel advances another step and one of its contacts is carried under the brush or lever controlling the other pole of the battery, and by this means a current, the reverse of the former one, is sent to line and again the contact wheel is locked and the line put to earth.

It will be noted that the duration of these line contacts is not dependant upon the time the operator holds his key closed, and that he simply regulates the time when a marking current shall be followed by a clearing current. In the interval between these currents the static condition of the cable is analogous to an actual battery charge in so far as its effect on the receiving instrument is concerned, provided that the receiving instrument is sufficiently susceptible, and it is by means of this static condition that dashes are produced through this transmitter.

By this ingenious arrangement, Mr. Burke has entirely overcome one of the most serious obstacles to Morse work on long submarine cables.

ARC LAMPS FOR OPTICAL PROJECTION.

BY

Robert P. Dobbie

NOTWITHSTANDING the fact that an arc light is by far the best possible illuminant for optical projection, it has by no means come into general demand, and the few that are at present in use—mostly in colleges and similar institutions—show a want of study and specialization for the particular purpose for which they are intended. It is considered sufficient to shorten an ordinary street lamp, made for quite a different service, and to use it, in a great many cases, without even a focussing device.

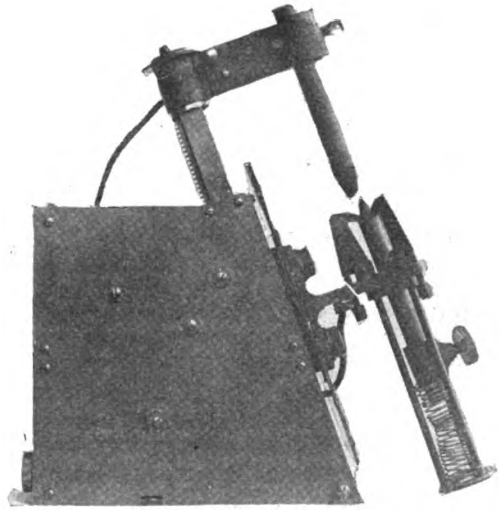


FIG. 1.—DOBBIE ARC LAMP FOR OPTICAL PROJECTION.

For an illuminant or "Radiant," as Mr. Louis Wright calls it in his excellent work on "Optical Projection," the following requirements are necessary: 1. Brilliance, or power and whiteness. 2. Steadiness. 3. Radiation from *one*, *small* surface. 4. "Radiant", to remain in one fixed position.

The arc fills all necessities as to the first requirement. Its quality and quantity are far superior to its nearest rival the oxy-hydrogen or lime-light; the latter is yellow compared to an arc, and under the most favorable circumstance 1,000 to 1,200 c. p. is the utmost that can be reached by it; 500 to 700 c. p. is far more usual, and is generally called a "good" light. This is measured straight in front and on the same level, and does not express the mean spherical value. An arc lamp, with 10 amperes, at 48 volts, will give over 2,000 c. p. (measured in the same way), and 15 to 25 amperes can be used if necessary, but which is seldom the case.

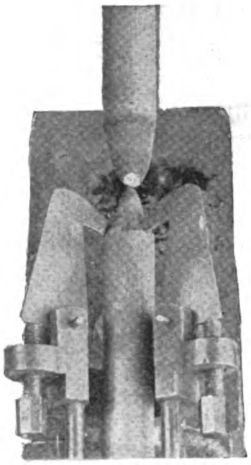


FIG. 2.

The second requirement, of steadiness, is not quite so easily attained by an arc lamp, but in the present state of the art steady dynamos, good carbons and proper appreciation of the conditions to be fulfilled, no trouble should be experienced.

The writer succeeded in showing the recent election returns at the Brooklyn *Eagle* main office, on the evening of November 8, with a lamp, shown in Fig. 1, using 18 to 20 amperes, and although the light was so powerful, flickering and flaming were absent. There were three 2,000 c. p. street lights within 40 to 50 feet of the screen, but they did not affect the view on the screen to a noticeable extent, while a projection from a lime-light stereopticon, a few doors up the street, was hardly visible under the same conditions. The same lamp was used in my recent lecture before the New York Electrical Society.

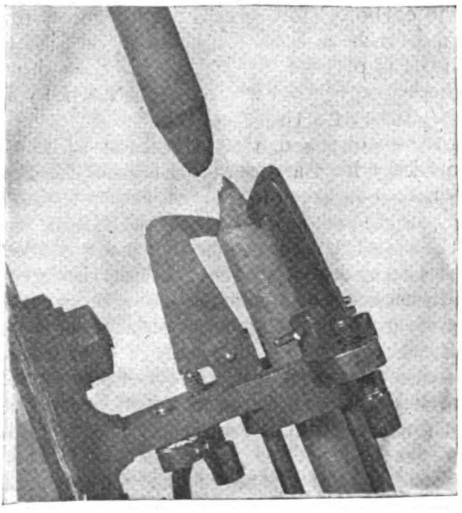


FIG. 3.

The third desideratum is easily met if the carbons are properly disposed. If they are vertical in relation to the condenser, the crater is not in the best position; even if the negative carbon is advanced toward the condensers, out of line with the positive, light will also proceed from the negative carbon as well as from the positive, thus making *two* sources of light instead of one, a condition fatal to fine definition on high-class work, such as microscopical subjects. If, however, the carbons are tilted about 20 degrees from the vertical, the luminous spot on the negative carbon is obscured from the condenser, and the crater on the positive carbon is presented in a most favorable way. Fig. 2 shows an engraving of the carbons, with the crater painted white. It will be observed that the crater squarely faces the front—that is, the condenser. Fig. 3 is a side view showing the luminous spot on the negative carbon, also painted white; but on reference to Fig. 2 it will be noticed that it is hidden from view.

Under these conditions, we practically have as radiant one surface about $\frac{1}{8}$ inch in diameter (the light proceeding from other parts of the carbon is very inconsiderable compared to that from the parts painted white), and this more nearly fulfils theoretical perfection—that is, a point, than any other illuminant; the lime-light, for instance, having a light radiating surface $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter, or from 16 to 35 times as large in area.

The last requirement is easily fulfilled, so easily, in fact, that I am surprised to find lamps without this provision—continuous manual adjustment of focus being necessary. The usual device is to fix both carbons in rack-driven holders that approach each other at proper speed. This is open to the objection that one particular combination of racks and gears, etc., is suitable to only one ratio of positive and negative carbon, and often to one particular make of carbon and strength of current.

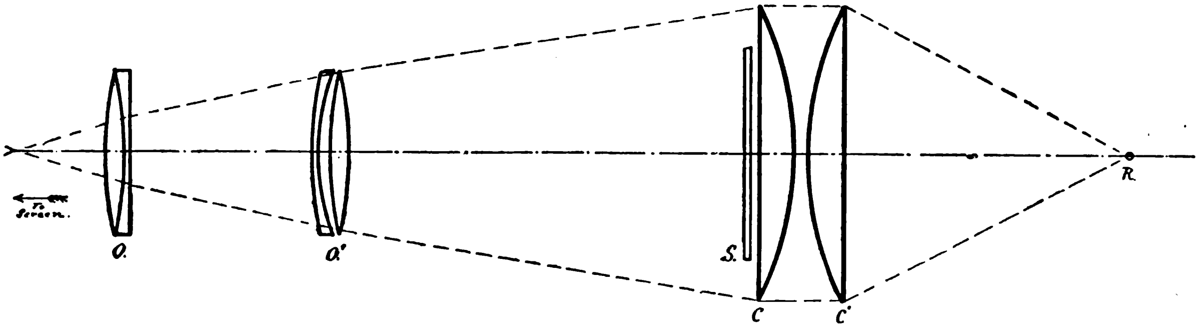


FIG. 4.—DIAGRAM SHOWING USUAL ARRANGEMENT OF OPTICAL LANTERN.

The device shown in Figs. 2 and 3 is one that I have found to work perfectly, and which does not possess this defect. The carbons abut against three points or hooks, set together in a circle a little less than the diameter of the carbon, which is pressed up by a spring, as shown in Fig. 1. As the carbon wears away it is fed up by increments of $\frac{1}{6}$ to to $\frac{1}{32}$ inch at a time.

It might be supposed that the heat of the arc would melt the hooks, which are made of copper; but in practice they do not, as conduction and radiation come into play, the hooks being specially designed with that end in view. I have attempted to construct a lamp with *both* carbons operated in this manner, but the positive side gives trouble; if the arc flows for an instant the points are gone, but in careful hands good results can be obtained. In the accompanying engravings, reproduced directly from photographs, I have painted the crater white in order to show clearly how it is presented to the condensers, and have also placed a white spot on the illuminated part of the negative carbon, which can be seen in the side view, but is obscured.

I have also thought it well to add here a sketch in the sectional view, Fig. 4, showing the usual arrangement of an optical lantern. Here, R is source of light or "radiant"; C C¹, the condensers; S, the slide; and O O¹, the objective.

It is very common to use triple condensers, but the results obtained from them are inferior to the ordinary double plano-convex arrangement, shown in Fig. 4, at C C¹, and for the following reasons:—The arc is too close to the anterior surface, and breakage is frequent. The color correction is no better, and the gain of light is insignificant, as the marginal rays, striking the condenser at an obtuse angle, are reflected instead of being refracted and transmitted, and the distribution of light over the slide S, is uneven.

The disposition of the carbons, and the method of feeding the negative carbon, are from 30 to 40 years old, and I disclaim any "new idea" or "great invention" in this apparatus. But I do wonder that the essential requisite of presenting the crater of the positive carbon has not been better understood and applied, and that such a simple device as the spring feed of the negative carbon, so old, has not been more generally used.

A NEW METHOD OF FIELD EXCITATION.

BY

H. L. Tyler.

ALTHOUGH the dynamo of to-day is a grand achievement, it possesses numerous disadvantages, and in attempting to obviate these the unipolar type of machine invariably suggests itself as the ideal, because it generates a continuous current and needs no commutator to enable it to excite its own magnets. It may be truthfully said that this is its only great advantage in view of the fact that for distribution the alternating current is preferable. But, whatever may be said in favor of the above machine, the results of years of experiment have given rise to the general conclusion that "it is impractical to construct an efficient self-exciting dynamo of uni-polar design." In constructing a generator the three most desirable attainments in the abandonment of the commutator are: Reduced first cost; no complicated parts; and freedom from sparking. The evil effects of the latter are too prevalent and too well known to be mentioned.

For a long time the writer has been at work on a machine designed to overcome at least some of the bad features of ordinary dynamos, and one has been produced embodying the desirable points above noted, although it is not a unipolar generator. The engraving Fig. 1 shows the machine in perspective, while Fig. 2 shows its construction diagrammatically. As will be seen the dynamo is of the stationary armature type and the method of exciting the inner revolving field constitutes the novel feature. The exciting current is fed to the field through the pole-changer shown in Fig. 2. The "changer" receives an alternating current and alternately feeds the fields, the four sections of each ring being only the terminals of the field coils, and not for the purpose of delivering the current in a uni-direction to the fields. In fact, the pole-changer delivers the current practically in the same state (alternating) as it is generated.

In Fig. 3 as the north magnet pole passes the armature coil at D the current from this coil enters at field coil terminal 1, passing around poles N¹ and N², leaving at terminal 2^a. Therefore, the lines of magnetic force are forced outward at N^1 and N^2 and drawn in at S^1 and S^2. When the south pole comes before the armature coil the current of course reverses, and as the pole-changer has made a quarter turn the current enters the field coil at 3, passing around poles S^1 and S^2 and leaving at 4^b,—producing the same magnetic polarity in all four poles as resulted when the current was in the coils of poles N^1 and N^2.

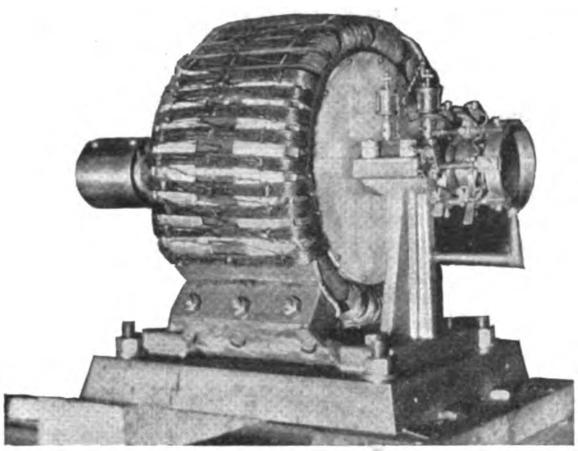


FIG. 1.—THE TYLER NON-COMMUTATING DIRECT CURRENT DYNAMO.

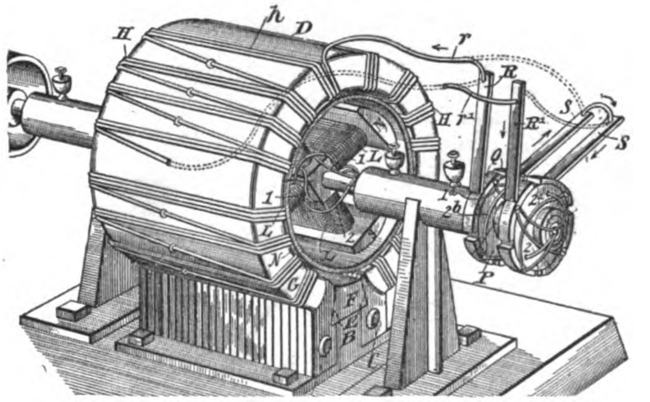


FIG. 2.

This method of field excitation at first appeared impractical; but I have repeatedly tested it with gratifying results. There is no sparking whatever, even on a dead short-circuit. The dynamo is made absolutely noiseless by a thin non-magnetic casing encircling the fields.

There are any number of ways to place the armature coils, but it appears unnecessary to designate them here.

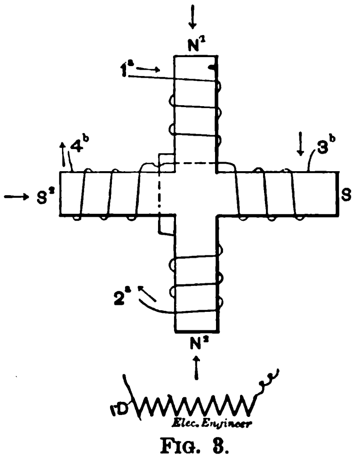


FIG. 3.

The general nature of the machine admits of first-class construction at a surprisingly low cost and its high efficiency and simplicity are among its best commendations.

THE FIRST ELECTRICAL TREATISE OF GALVANI.

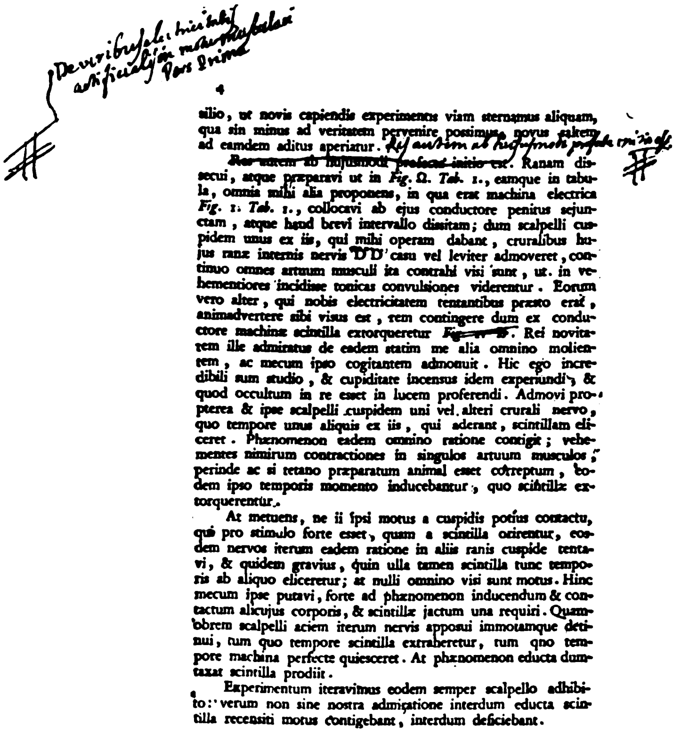
BY

Park Benjamin

THE first publication on the subject of his electrical discoveries was made by Galvani in Volume 7 of Antichi Commentarii del Instituto di Bologna, in 1791. Prior to that he had printed four memoirs or treatises, mainly on medical and chemical subjects, entitled as follows: "De Ossibus," "De Renibus," "De Manzoliniana Supellectili" and "De Volatilium Aure."

Apparently coincidental with the appearance of the volume of transactions above named, Galvani's essay, "De Viribus Electricitatis in Motu Musculari," was printed by the Bologna Institute separately; but only a very few copies were thus issued. In 1841 the Institute received, by bequest from Galvani's son-in-law, Aldini, quite a number of Galvani's papers and manuscripts, and in that year it caused to be published, under the editorship of Professor Gherardi, a complete collection of all of Galvani's writings. In commenting on Galvani's essay separately, issued in 1791 at Bologna, Gherardi refers to it as of the most extreme rarity. The edition of Galvani's "De Viribus," which is ordinarily considered the first, is dated 1792. It was published in Modena, and it contains a commentary by Aldini and a long letter to Carminati. There is only one other well-authenticated treatise, which was published by Galvani during his lifetime, namely, that on "Animal Electricity," addressed to Spallanzani in 1797. There are two doubtful treatises on "The Conducting Arc," published in 1794, concerning which it is uncertain whether they were the work of Galvani or Aldini.

The Royal Society catalogue credits them to the latter. The Ronalds catalogue, as usual, blunders concerning all of this. It leaves out all mention of the 1791 issue and reports the existence of an essay entitled "Propositione de Electricitate" under date of 1786; and, to make matters worse, asserts that such an essay is in the Ronalds collec-



De viribus electricitatis
artificialis in motu musculari
Pars Prima

4

silio, ut novis capiendis experimentis viam sternamus aliquam, qua sin minus ad veritatem pervenire possimus, novus saltem ad eamdem aditus aperiatur. Res autem ab hujusmodi profecta initio est.

~~Res autem ab hujusmodi profecta initio est.~~ Ranam dissecui, atque præparavi ut in *Fig.* Ω. *Tab.* I., eamque in tabula, omnia mihi alia proponens, in qua erat machina electrica *Fig.* I. *Tab.* I., collocavi ab ejus conductore penitus sejunctam, atque haud brevi intervallo dissitam; dum scalpelli cuspidem unus ex iis, qui mihi operam dabant, cruralibus hujus ranæ internis nervis DD casu vel leviter admoveret, continuo omnes artuum musculi ita contrahi visi sunt, ut in vehementiores incidisse tonicas convulsiones viderentur. Eorum vero alter, qui nobis electricitatem tentantibus præsto erat, animadvertere sibi visus est, rem contingere dum ex conductore machinæ scintilla extorqueretur ~~*Fig.* [illegible]~~. Rei novitatem ille admiratus de eadem statim me alia omnino molientem, ac mecum ipso cogitantem admonuit. Hic ego incredibili sum studio, & cupiditate incensus idem experiundi, & quod occultum in re esset in lucem proferendi. Admovi propterea & ipse scalpelli cuspidem uni vel alteri crurali nervo, quo tempore unus aliquis ex iis, qui aderant, scintillam eliceret. Phænomenon eadem omnino ratione contigit; vehementes nimirum contractiones in singulos artuum musculos, perinde ac si tetano præparatum animal esset correptum, eodem ipso temporis momento inducebantur, quo scintillæ extorquerentur.

At metuens, ne ii ipsi motus a cuspidis potius contactu, qui pro stimulo forte esset, quam a scintilla orirentur, eosdem nervos iterum eadem ratione in aliis ranis cuspide tentavi, & quidem gravius, quin ulla tamen scintilla tunc temporis ab aliquo eliceretur; at nulli omnino visi sunt motus. Hinc mecum ipse putavi, forte ad phænomenon inducendum & contactum alicujus corporis, & scintillæ jactum una requiri. Quamobrem scalpelli aciem iterum nervis apposui immotamque detinui, tum quo tempore scintilla extraheretur, tum quo tempore machina perfecte quiesceret. At phænomenon educta dumtaxat scintilla prodiit.

Experimentum iteravimus eodem semper scalpello adhibito: verum non sine nostra admiratione interdum educta scintilla recensiti motus contigebant, interdum deficiebant.

FAC-SIMILE OF A PAGE FROM GALVANI'S FIRST ELECTRICAL TREATISE.

tion, and that it was published at Bologna. If the Ronalds library does possess such a work, it is singular that the Institute of Bologna should know nothing about it and should carefully refrain from making any mention concerning it in its very voluminous and elaborate publication of all of Galvani's writings. The statement is probably about as accurate as the accompanying one, to the effect that Galvani died in 1789; a period during which he was very much alive and busily engaged on some of his most important work. If the Ronalds catalogue could be properly edited, students of electricity, the world over, would be greatly benefited.

Judging from a moderate experience in collecting the rarities of electrical literature, I am inclined to believe that there is nothing more scarce than this first work of Galvani. The copy in the possession of the writer is, of course, unique, for it contains the corrections made by the philosopher's own hand, which I find, by comparison, were incorporated exactly as here directed in the following edition of 1792. Accompanying this is a fac-simile reproduction of p. 4 of the work, in which Galvani describes his historical experiment with the frog, and of which a translation, in part, is given below:

> I dissected a frog, and prepared it as in Fig. 2, Plate V., and, putting it on the table on which was the electrical machine (Fig. 1), I placed it wholly disconnected from its conductor, and separated from it by an interval not short. One of those who were assisting me in the work lightly touched by accident, with the point of the scalpel, the internal nerves D D in the legs of the frog, when all at once every muscle of the joints was seen to be contracted, so that they seemed to have fallen into the most vehement and violent convulsions.

I have just received the book from Italy. The handwriting of Galvani needs no authentication, although I have it well authenticated; for comparison of it, letter by letter with the fac-similes of Galvani's manuscript published by the Bologna Institute, leaves no possible doubt that the writing, in both cases, was made by the same hand.

These books come to light, nowadays, only apparently when some one dies and a library is scattered. This seems to have been the present state of affairs; for the intelligent book detective whom I have in Italy sends me at the same time the original publications of Salvator Dal Negro, Pivati and others, none of which seems to have got into the general book market.

While on the subject of scarce electrical works, and as the aim of every electrical collector is a copy of the original Gilbert (1600), it may be of interest to add that this book is appearing in numbers which make it less of a rarity than it was regarded some years ago. There are probably a dozen copies in this country. The editions of 1628 and 1630 are more scarce than the first edition, and the posthumous work of Gilbert (1651) is rarer than either. A fac-simile copy of the 1600 edition has just been published in Berlin, and the first English translation will shortly be published in this city, thus forestalling the much be-trumpeted effort of the English Gilbert Society.

And that, by the way, reminds me to suggest that electrical genius is represented in Central Park only by an exasperating statue of Morse—not as bad, it is true, as that of Halleck with his head screwed on, or Scott with the mansard cranium, or Burns leaping from the painful tack—but still a horror. There ought to be another statue there mating that of the friend and contemporary who wrote into his plays the medical knowledge Gilbert taught him. The poets and actors have erected a statue of Shakespeare on our great pleasure ground; cannot the electricians put beside it one of Gilbert?

THE HAZELTINE DOUBLE-PLATED CARBON.

Various devices have been proposed for prolonging the life of carbons in arc lamps and enable a single-arc lamp to burn all night or to perform the functions of a double-arc lamp and to effect a material saving in carbon and in labor in trimming.

Mr. C. W. Hazeltine, of St. Louis, Mo., has recently discovered that by coating the carbons with copper, of about the same thickness as that usually employed, and then with a heavier coating of zinc, the carbons can be made to burn nearly twice as long as with merely the copper covering. Several theories are advanced by the inventor to account for this, one being that the heat of the arc forms oxide of zinc which permeates the copper coating, closing its pores and preventing the access of cold air; and another, that the zinc oxide, covering the copper, protects it and prevents its burning away above the arc.

The oxide of zinc, though infusible, is readily carried away into the air, or forms a slight deposit at the bottom of the globe.

Other combinations of metals have been experimented upon by Mr. Hazeltine with good results.

THE NEW LUNDELL MOTOR.

Our readers will remember the description which we published some months ago of the Lundell fan motor. This machine was characterized by the novel design embodied in its magnetic circuit, the field being of the iron-clad type, and energized by a single coil. The success obtained with this small machine, which was built by the Interior Conduit and Insulation Company, of this city, was such as to warrant the application of the same principles to larger sizes, and as a result Mr. Lundell has now worked out a series of motors ranging in size from ¼ h. p. to 10 kilowatts, in which the same principles are applied, and additional improvements have been introduced.

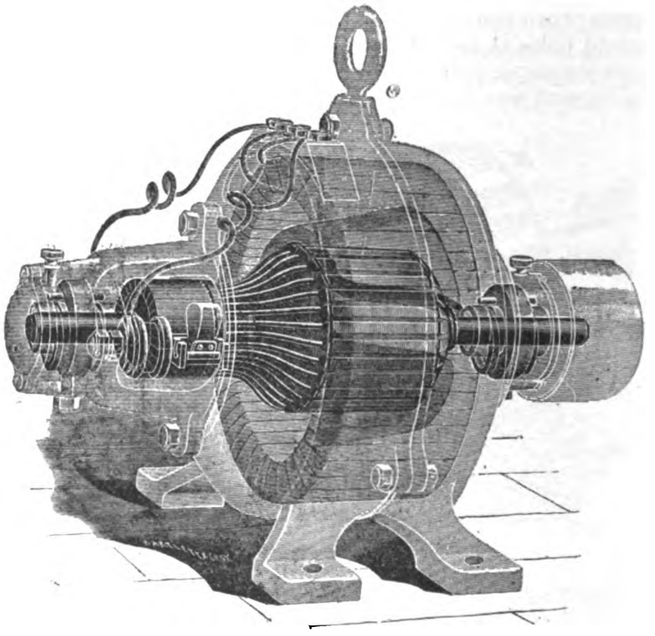


Fig. 2.—Skeleton View of New Lundell Motor.

The machines of larger power are of the general form illustrated in the engraving, Fig. 1. The arrangement of the fields and energizing coil is very clearly shown in the illustrations, Figs. 2 and 3, the latter showing the two halves separated with the energizing field coil between them. While the spherical form of field was eminently adapted to small fan work, it is evident that when it is desired to attach the motor directly to a pump, or other device, the cylindrical is better adapted as being somewhat more compact and admitting of a shortening of the machine, so that it occupies less space.

In the present construction, it will be noted that the magnetic shell also completely protects the armature; and the whole shell is utilized in the magnetic circuit. It has been so designed that the cross-section of the shell equals the cross-section of the base of the pole-pieces, so that no choking of the lines of force can occur at any point. The adoption of the single energizing coil not only reduces the construction of the machine to the simplest point, but by having only two terminals it is specially adapted to be placed in the hands of inexperienced users, as it avoids any possible mistake in connecting up or any bother or delay in examination when such becomes necessary. Another feature of the design adopted, it will be noted, is that the pole-pieces can be magnetized directly, while, to a large extent the direct magnetization of the armature is also accomplished, so that a considerable economy in the ampere terms of the energizing coil is thereby affected.

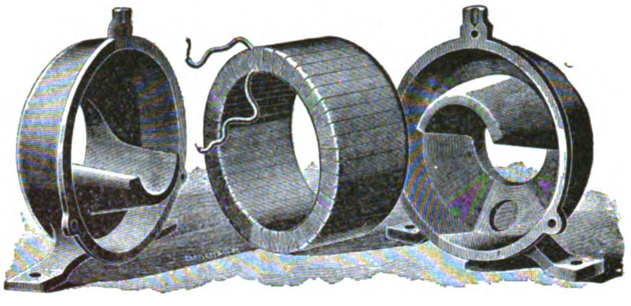


FIG. 3.—FIELDS AND ENERGIZING COIL.

In designing the armature of these machines, Mr. Lundell has adopted the Pacinotti form, Fig. 4. This type of armature has in the past been subject to unfavorable criticism on account of the resultant heating of the pole-pieces, but it is now pretty well recognized that this heating was not due to the Pacinotti ring itself, but to the lack of knowledge with regard to its proper design. A little reasoning will show that when the ratio of the distance between the teeth and the magnetic gap is too small, a concentration of the lines of force will take place so that the pole-pieces will be swept over alternately by sections of the highly concentrated lines of force, and by practically inert material. The result is that Foucault currents must inevitably be set up in the pole-pieces and cause the heating, which has been noted in the past. By so proportioning the teeth, however, that the lines of force emanating from the pole-pieces are more evenly distributed over their entire surface surrounding the armature, this abrupt demarkation is avoided, with the result that Foucault currents are also avoided in the pole-pieces.

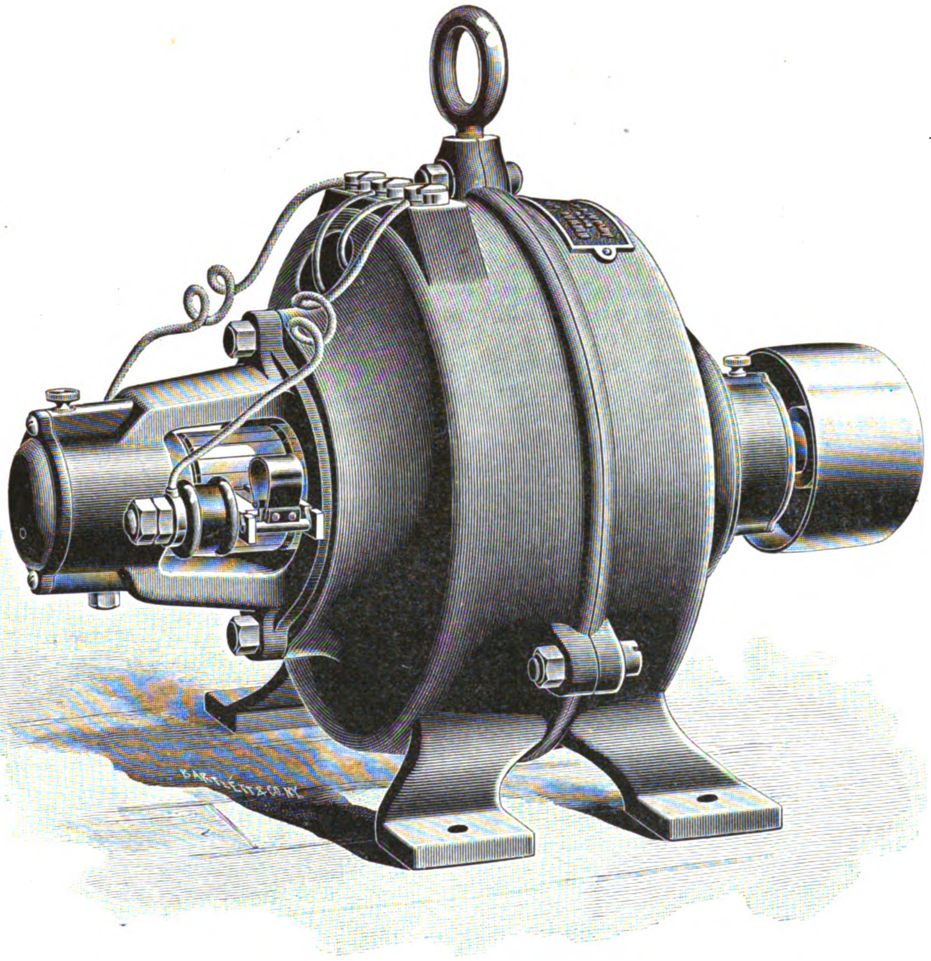


FIG. 1.—THE NEW LUNDELL IRON CLAD MOTOR.

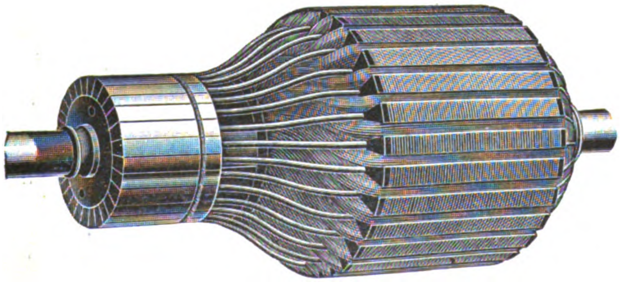


FIG. 4.—ARMATURE OF LUNDELL MOTOR.

The result of actual practice with the Lundell machine has shown the soundness of this theory, which is carried into practice by the employment of deep and narrow slots. The mechanical design of the machine has also been carefully worked out.

Notwithstanding the iron-clad nature of the machine, the concentric position of the field coil allows the armature to be withdrawn without disturbing either the field coil or the pole-pieces. The commutator is also well protected between the two limbs of a broad, strong bracket.

A very ingenious spring arrangement for pressing the carbon brushes against the commutator has been devised

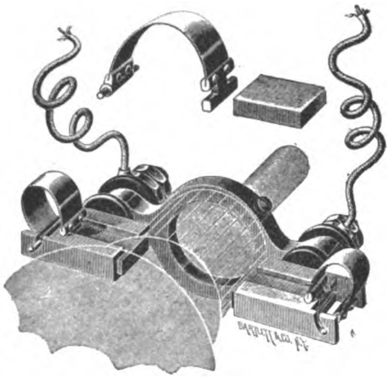


FIG. 5.—LUNDELL BRUSH HOLDER.

by Mr. Lundell, and is shown in the engraving, Fig. 5. The spring which is shown enlarged in the upper half of this engraving, has its rear end placed in a curved slot at the end of the brush holder; while its forward end in the shape of a T presses against the carbon which slides in the ways in the brush holder. To remove the carbon, it is merely necessary to press the spring upwards out of the slot which releases it, so that the T can be withdrawn, and the carbon slides out.

Recognizing also the necessity of continuous lubrication, Mr. Lundell has designed an ingenious oiling arrangement shown in the engraving, Fig. 6. The oiling is accomplished by means of a number of rings which encircle the shaft and dip into the reservoir, thus continually feeding fresh oil to the bearing. In order that the attendant may know the exact condition of the oil a simple oiling device has been added, consisting of a double elbow with an oil chamber and rising slightly above the normal level of the oil.

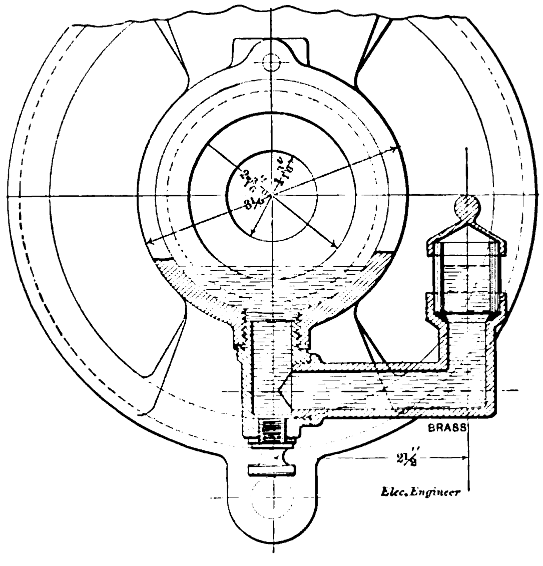


FIG. 6.—LUNDELL OIL RESERVOIR.

The vertical arm of this elbow has been so arranged that the normal height of the oil corresponds exactly with the level of the top of the elbow, so that by no possible inadvertency can the attendant pour in oil sufficient to flood the bearing and cause the oil to run out at the inner surface of the shaft and so go into the armature. This visual gauge arrangement is provided with a short length of glass tube. When the oil is on a level anywhere within the compass of the glass tube it is an indication that the amount provided is sufficient for lubrication, so that the attendant cannot be left in doubt as to the proper quantity of oil required.

These machines, which have been carefully worked out in all the details, are wound for any circuit, and are exceedingly compact for their power.

INCREASED COMMERCIAL EFFICIENCY AN HIGHER ECONOMY IN CENTRAL STATIONS.—IV.

(*Conclusion.*)

BY

J. H. Vail

COMMERCIAL EFFICIENCY.

LET us keep prominently before us the fact that a small percentage of gain per horse power hour may be more than compound interest on extra investment, and *that the saving on the total horse power hours of a year's output will aggregate a large sum of money earned.* In considering commercial efficiency, we must not be satisfied with better efficiency of the dynamo engine, or boiler, but we must calculate on larger increased commercial efficiency of the entire improved central station as a unit when compared with central stations of existing and less efficient types.

Higher commercial efficiency is to be obtained by refinements of details, more accurate proportions of parts, greater perfection in mechanical details of manufacture, a more scientific combination of apparatus, and general high-class construction of the entire plant. The higher commercial efficiency of generating units will also be gained through using larger high class dynamos coupled direct on engine shafts, the engines being of the compound or triple-expansion type. To obtain this increased commercial efficiency of the entire station and system, we must investigate the merits of the individual boiler, engine, dynamo and system of distribution, that we combine to form the entire equipment.

As an illustration, we will assume that in the town of "A" the electric company have installed their plant and operate it under the following conditions: With boilers of low evaporative efficiency. With coal of poor steaming qualities. With loss in steam pressure between boilers and engines, due to small size of pipes, frequent bends and insufficient covering. With engines requiring 35 to 50 lbs. of water per horse power hour as well as excessive internal friction. With belted dynamos of 80 to 85 per cent. efficiency. With line construction of such high resistance that there is a loss of 20 to 40 per cent. between station and consumer.

Such a combined station cannot fail to be very low in its net commercial efficiency. In the town of "B" the installation comprises: Boilers that in daily practice have high evaporating qualties. The coal used gives the greatest evaporation of water per dollar expended. The steam piping is of ample size, free circulation, well covered, loss between boilers and engines reduced to the minimum. The engines are of high efficiency. The dynamos at least 90 to 93 per cent. efficiency. The loss in line distribution not more than 10 to 15 per cent. With the above aggregated, it is easy to see that the commercial efficiency of the entire plant and system in town "B" must be far superior to that in town "A," and yet in neither place have I assumed the use of any special appliances for saving coal or water.

A few words as to commercial efficiency of generating units. The highest efficiency heretofore obtained has been with the high speed engine belted to bi-polar dynamos. This combination frequently does not exceed 70 per cent. and when attaining so high as 75 per cent. is considered at best average maximum commercial efficiency. It will readily be understood that the more shafting and belting we introduce between the engine and driven dynamos, the greater the loss through friction and, as a consequence, the commercial efficiency is reduced. We should therefore aim to apply the driving power in the most direct manner possible. This can only be accomplished by mounting the dynamo armature direct on the engine shaft, thus avoiding all intermediate appliances.

The following data, obtained from tests of triple expansion engines and direct driven dynamos, will be interesting as showing the improvement in commercial efficiency as the load increases.

Comparative Commercial Efficiency of 2 x 50 K. W. Generator Under Various Loads.

Fields charged. Friction load.	Load—Watts.	Electrical horse power.	Indicated horse power.	Commercial efficiency.
				Full speed.
18.22 h. p...	1,100	1.47	18.22	
	11,900	15.95	33.41	47.7 per cent.
	23,900	32.	51.32	62.5 “
	35,850	48.	69.40	69.1 “
	48,000	64.34	91.58	70.2 “
	60,250	81.	113.2	71.5 “
	72,650	97.38	130.9	74.3 “
	85,400	114.47	148.13	77.2 “
	109,550	133 44	166.3	80.2 “

Comparative Commercial Efficiency of 2 x 200 K. W. Generator Under Various Loads.

Friction load.	Load.		Electrical horse power.	Indicated horse power.	Commercial efficiency.
	Amp.	Volts			
					Full speed.
105.3 h. p...	400	126	67.7	198.0	34.2 per cent.
	800	126	135.0	381.0	25.2 “
	2,600	124	432.1	561.8	76.9 “
	2,932	126	479.1	614.6	77.9 “
	3,100	125.5	521.5	631.6	82.5 “
	3,400	125.	569.	664.	85.6 “

I have no doubt that an actual commercial efficiency above 90 per cent. will eventually be attained by further improvements in direct driven generators.

The above tests make three points clearly worthy of attention :

1st. That 100 h. p. is too small a capacity for economical service from a triple-expansion engine, because, while it costs much in excess of the simple high pressure engine and belt driven dynamos, its commercial efficiency shows only 75 per cent., being on a par with the commercial efficiency of the latter class of plant.

2nd. That below half load, the generators of either size show too low in commercial efficiency to warrant their use under small load.

3d. That in units of large size, we attain an efficiency above 82 per cent., and that the efficiency will increase with size of unit.

The higher commercial efficiency gained will more than compensate for the better class and cost of engineering talent, which will be required to design these new stations, as well as the higher grade of skilled engineers required to operate the improved type of station.

ON A METHOD FOR BALANCING ARMATURE REACTIONS.[1]

BY HARRIS J. RYAN.

THE generators or motors are constructed in the ordinary manner except that holes are bored through the pole-pieces immediately back of the surfaces through which conductors are wound in sufficient number and in such a manner that the armature current passing through them shall oppose and equal the magnetizing effects in the armature conductors at all points. This method was suggested as early as 1886, but was never practically demonstrated until three years ago, when the author applied it to actual designs. During the past two years investigations of its practical application to actual machines have been conducted by him, and, with the assistance of Mr. M. E. Thompson, fellow in electrical engineering at Cornell, six machines have been designed, two of which are already constructed, each representing a distinct line of practice.

Very satisfactory results were obtained with both machines experimented upon, the second of which will be considered to show the results thus far obtained. This is a four pole incandescent dynamo for which the following data are given :

Output, 40 amperes at 100 volts and 1,200 r. p. m. Type of machine, 4-pole ; field of cast iron in two pieces. Armature: drum winding through 58 grooves; 5 No. 10 B. & S. G. wires in each groove ; winding in two circuits ; 29 commutator bars ; grooves milled out, size $\frac{5}{8}$ in. x $\frac{9}{64}$ in.; outside diameter of core $7\frac{1}{2}$ in., inside 3 in., built up of discs; surface of completed armature wound with No. 14 B. & S. G. iron wire. Length of armature and poles, 6 in. each. Effective length of iron in armature core, 5 in. Magnetic leakage, 15 per cent. Field cores, 5 in. x 2 in., with rounded ends; area 9.14 sq. in. Mean length of field magnetic circuit, 12.5 in. Magnetic density in the armature core, 5,400; in the air gap, 4,900; in the armature lugs, 8,400; in the field cores, 6,800. Field winding: mean length of a turn, 15 in.; requisite exciting M M. F. for field circuit, 910 ampere turns; for armature, 25 ampere turns; for air gap, 1,000 ampere turns ; or a total of 1,935 ampere turns; requisite size of wire for excitation at 100 volts, 1,575 cir. mils.; size of wire adopted, No. 18 B. & S. G., enough being used to bring down the exciting current density to 1,000 cir. mils per ampere. Total weight of machine : 400 pounds.

The number of balancing conductors on each pole face is found as follows : Armature conductors under a pole × current in the pole = balancing conductors back of each pole face × total armature current through them.

The ordinary pernicious effects of so short an air gap with a comparatively large number of ampere turns are not observed in this case, and the machine acted exactly as theory shows that it should if armature reaction were absent. The poles covered 90 per cent. of the armature circumference so that the back ampere turns were negligible. When separately excited, the machine could be loaded down to 100 amperes when the drop in E. M. F. at the brushes was no greater than that due to the ohmic resistance of the armature. The neutral point was not shifted. When self excited the lowering of the field excitation produced a little more drop, while the magnetic density in the air gap was found to be the same at normal load as at no load.

Operated without the balancing coils, even at a speed of 1,800 instead of 1,200 revolutions, it was impossible to get a greater output than 37 amperes at 85 volts, for, considered as an ordinary machine, there is too little material in the field cores, poles and winding and too great a number of ampere turns on the armature.

Cross induction may be entirely avoided, or even reversed in its effects by the use of the balancing coils ; the magnetization through the poles, air gap and armature does not undergo a redistribution under any load ; the armature current does not alter the total magnetization through the armature at any value ; the neutral point remains constant ; the diameter of commutation with metallic brushes changes only by the small amount necessary to balance the self-induction of the commutated section by the field in which it is moving ; regulation for constant current may be effected without change of the diameter of commutation by varying the magnetization through any limits. By proper designing, the output for a given weight in the completed machine may be quite largely increased over that which is realized in the common practice of to-day, and the air gap may be made as small as mechanical requirements will permit without changing the performance of the machine, thus enabling one to realize practically the advantages of differential excitation that is utilized so successfully in the modern alternate current transformer.

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[1] Abstract of a paper published in the *Sibley Journal of Engineering* October, 1892.

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Vol. XIV. NEW YORK, DECEMBER 7, 1892. No. 240.

Truisms which one has verified for one's self out of a personal experience are apt to have a special value to the owner.—S. P. Langley.

NOT ABSORPTION, BUT COMPETITION.

THE sporadic rumor of an early absorption of the Westinghouse Company by the General Electric Company has again found some lodgment in electrical circles during the past week. Aside from the emphatic denials of leading officials of both companies, abundant reason for discrediting the report is to be found in the present circumstances of the Westinghouse Company. The golden opportunity of the capitalists and organizers who formed the General Company for acquiring the property and business of the Westinghouse Company would seem to have passed a little over a year ago, when it was hard pressed and before its successful reorganization. Its prosperous business for a twelvemonth and the prestige acquired through its World's Fair contract have put the company in a position of independence hardly to have been expected from the outlook in the autumn of 1891. To the success of the General Company in maintaining the Edison Lamp patent in the court of last resort, the Westinghouse Company promptly responded by announcing the early introduction to the market of a new and non-infringing lamp at a great reduction from prevailing prices. Through the daily press and in the advertising columns of electrical journals it now quotes prices and offers to fill orders from and after January 1, 1893. The rates named, viz.: 30 cents for 16, 10 and 8 c. p.; 35 cents for 25 and 20 c. p. with discount of from 2½ to 10 per cent., according to quantity, are indeed surprisingly low. The lamps' advent will naturally be eagerly looked for by consumers, and, perhaps, with mixed feelings by other lamp manufacturers, including the General Company. Supplementing his low prices, Mr. Westinghouse offers a further advantage in an allowance of 10 cents each for every unbroken burned-out lamp returned to the factory. Mr. Westinghouse estimates the saving over existing rates thus open to central station companies as equal to one per cent. on their capital stock. Even if that estimate be too high there can be no doubt that a supply of satisfactory lamps at the quoted rates and terms would effect a very large saving to operating companies and other consumers.

The energetic competition of the Westinghouse and other companies with the General Company is a most gratifying and encouraging feature of the present situation of electrical industry. The danger apprehended by many of the successful establishment of a gigantic and comprehensive monopoly, combine or "trust," can best be avoided not by denouncing the General Electric Company, but by effectively resisting it on economic principles and by business methods.

500-VOLT MOTORS.

In most of our cities, motors are now run chiefly on 110 or 220 volt circuits, a few being found also on arc series circuits. There appears to be, however, a marked tendency towards the use of constant potential motors, at as high a voltage as 500, not merely on railway circuits, but in regular power work. Mr. A. C. Balch, the electrical engineer of the Union Power Company of Portland, Ore., writes us that they now have in operation something over 700 h. p. of 500-volt motors. It would, he remarks, be a financial impossibility to run at any lower voltage, as the station is three miles from the centre of distribution. The 500-volt machines have given little, if any, extra trouble as compared with the 110 or 220 volt motors.

This is interesting and encouraging, and is confirmed by the reports that reach us from another large city, where about 850 h. p. nominal is now being furnished with 500-volt motors, averaging 7½ to 10 h. p., and going up to 25 h. p. In this case, the station is about midway in a system of distribution stretching 5 miles, or about 2½ miles each side of it. The demand is growing, and the motors will reach 1,000 h. p. daily this year. As overhead circuits are used, the extensions of the service are made quickly and economically. Current is metered, and also sold at a flat rate, but prices, so far as we can learn, average four or five cents per horse power hour, and perhaps shade below that for large powers, running however, well up to ten cents for small powers.

We think the field here indicated is worthy of study by station managers. Motors of high voltage are now well built, and even in the smallest sizes are capable of yielding excellent results; while the saving of copper in the circuits is something enormous. But perhaps we shall not see the full possible development of this field until a higher volt incandescent lamp also makes its successful début. Meantime, in planning independent power circuits, managers should, we think, concentrate their energies and attention on 500-volt work, as being safe for the public, as more economical for themselves, and as admitting of the distribution of power over a much larger territory.

ELECTRIC RAILWAY DEPARTMENT.

THE LAKE ROLAND ELEVATED RAILWAY, BALTIMORE, MD.

BY

A. V. Abbott

THE year 1892 will always be conspicuous in the annals of American engineering as presenting an extraordinary Street Railway development. In proportion to its size, probably the city of Baltimore would lead the list in improvements in rapid transit facilities, for at the beginning of 1892 only one cable road was in operation in the city, while the end of 1892 will undoubtedly see at least four additional cable roads and five electric roads, aggregating two hundred or more miles of track in full operation. Conspicuously among the electrical equipments the Lake Roland Elevated Railway may be mentioned. The city termini of this road are located at the corner of Charles and Lexington streets and at the corner of Baltimore and North streets. From these points the road runs northerly through North street to North avenue, thence westerly to Oak street, where the line splits into two parts, one running nearly due north by Druid Hill Park, through Roland Park to Lake Roland, and the other running due west to the suburb of Walbrook.

On North street, to avoid conflict with the tracks of the Northern Central Railway, an elevated structure, built similar to the New York elevated railways, has been introduced, by means of which the tracks of the Lake Roland Road are raised sufficiently above the street level to carry them over the tracks of the Northern Central Road and allow free passage of locomotives and freight cars underneath the electric road.

ROADBED AND RAIL STRUCTURE.

Through the paved streets of the city, commencing at Charles and Baltimore streets, and extending as far north as Cold Spring Lane, Duplex street railway track has been used. The rail is supported in cast-iron chairs having bases 12 inches x 14 inches square. These chairs are set at intervals of 5 feet 4 inches. The gauge of the track is 5 feet 4 inches, there being an old-time ordinance in the city of Baltimore which limits all street railway tracks to this gauge. At each chair a tie bar connects the two rails of each track to prevent any possibility of spreading; thus it is obvious that the entire structure embedded in the street is of a metallic character and not liable to cause interruption of street traffic by rotting or disintegration of wooden ties. The bearing areas of the chairs have been carefully calculated so as to present a sufficient area in contact with the soil of the street so that there may be no settlement under carload. In cases where the subsoil of the street is particularly soft, a block of concrete is introduced under the chair to give additional bearing area. Through the city streets the wide tram section has been used to afford a rail which shall present little or no difficulty to street traffic. North of Cold Spring Lane, however, where the traffic of the street is limited to pleasure travel a narrow tram section is substituted for the previously described section. Outside of the paved streets of the city the roadbed has been very carefully graded, and has been provided with a gravel ballast one foot in thickness of cement gravel of such nature that, after consolidation by wear, dust will be almost

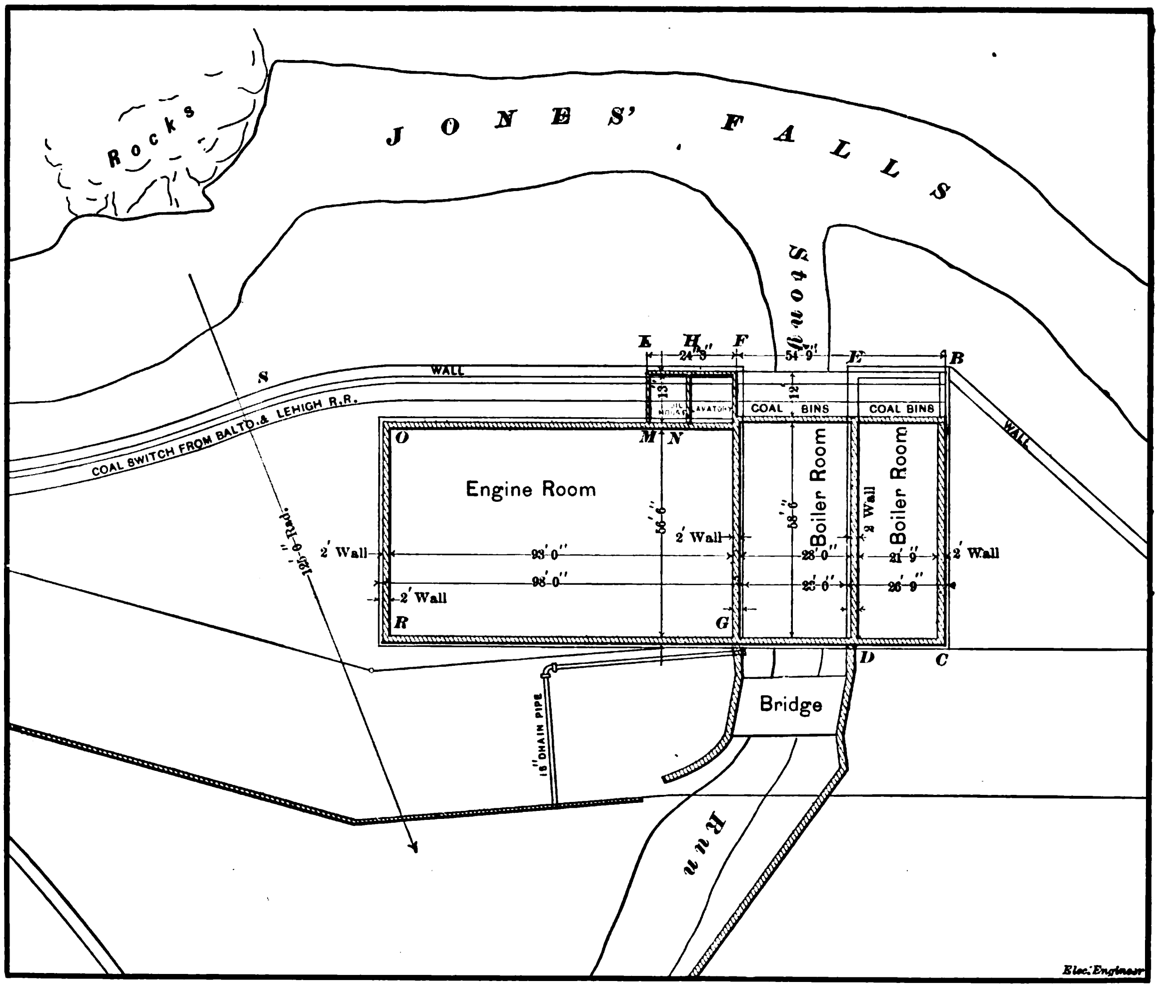


FIG. 1.—POWER PLANT OF THE LAKE ROLAND ELEVATED ELECTRIC RAILWAY.

entirely avoided. At the corner of North street and North avenue the road runs for a distance over the tracks of the Union Line and the Traction Co., and thence proceeds westward to the suburb Walbrook, about three miles into the country. On North avenue the track is composed of 75 lb. Johnson girder rail to a point a little west of Fulton avenue. From this point westward 67 lb. Pennsylvania Company T rail is used, as the streets are unpaved and the necessity for a girder rail is obviated. This part of the road is laid upon vulcanized Georgia pine ties set on 30 inch centres.

The elevated structure commences near Saratoga street, on North street, and extends northward for a distance of nearly 4,000 feet, nearly to Chase street. At each end of the structure the street grade is attained by means of a masonry approach of Gettysburg granite laid on a grade of six per cent. to raise the tracks of the Lake Roland Road to the height of 8 feet above street level. The end of each approach is furnished with a masonry bridge-seat on which rest four lines of Warren girders almost precisely similar in design and type to those of the New York elevated structures and supported on Z bar columns set on piers of Portland concrete. Through the greater part of North street the ground is sufficiently firm so that good foundation for the piers can be obtained with an excavation of about 8 feet. Toward the lower end, however, North street runs through the old bed of Jones's Falls stream where very marshy ground was encountered, necessitating a piled foundation for each of the piers. This piled foundation was accomplished by driving six piles, 8 inches in diameter at the small ends until the piles were firmly embedded in a layer of gravel situated about 18 feet below the street level. The tops of the piles were then cut off to a level grade of 8 feet below the street level and surmounted by a cap-stone 8 feet square and one foot thick, upon the top of which a concrete pier was placed. The tops of these piers are composed of granite cap-stones one foot thick and 24 inches square, carrying four foundation bolts which pass into the concrete and serve to secure the base of the Z bar column. A clear head-room of 20 feet is preserved under all parts of the elevated structure to give ample head-room for all street traffic beneath. The columns for a majority of the spans are 12 inches square; but for two of the long spans the columns are 15 inches square. In order to avoid the railway tracks at the Calvert street station, it has been found essential to introduce two long bridge spans into the elevated structure. These spans are respectively 196 feet and 156 feet centre to centre of end pins. The spans are steel through trusses. The entire elevated structure is built by the Pennsylvania Steel Company from open-hearth and Bessemer steel having an elastic limit of from 32,000 to 40,000 pounds to the square inch, an ultimate strength of from 54,000 to 62,000 pounds, an elongation of not less than 25 per cent. in 8 inches, and a reduction of area of not less than 45 per cent.

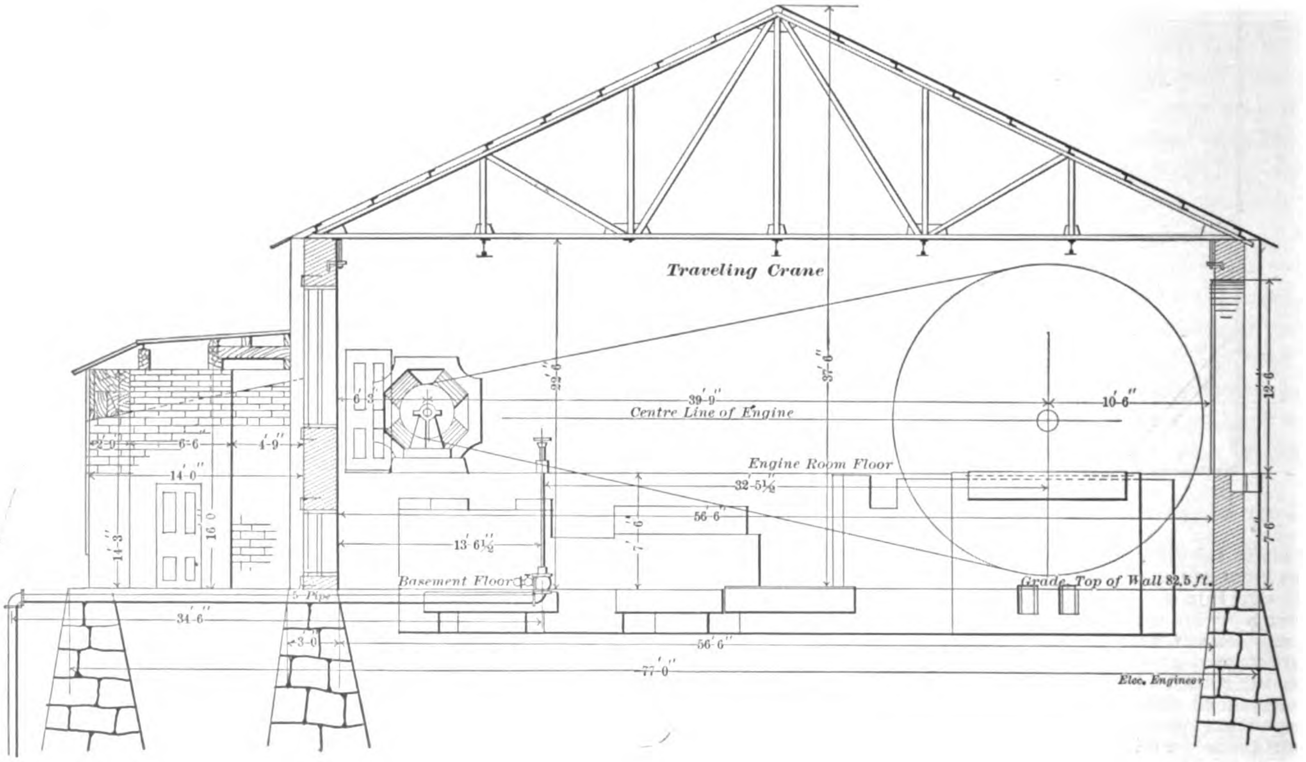


Fig. 2.—Section Through Engine Room.

Another steel structure about 600 feet in length occurs where the road crosses Stony Run stream just north of Hampden avenue, where the grade is about 60 feet above the level of the stream.

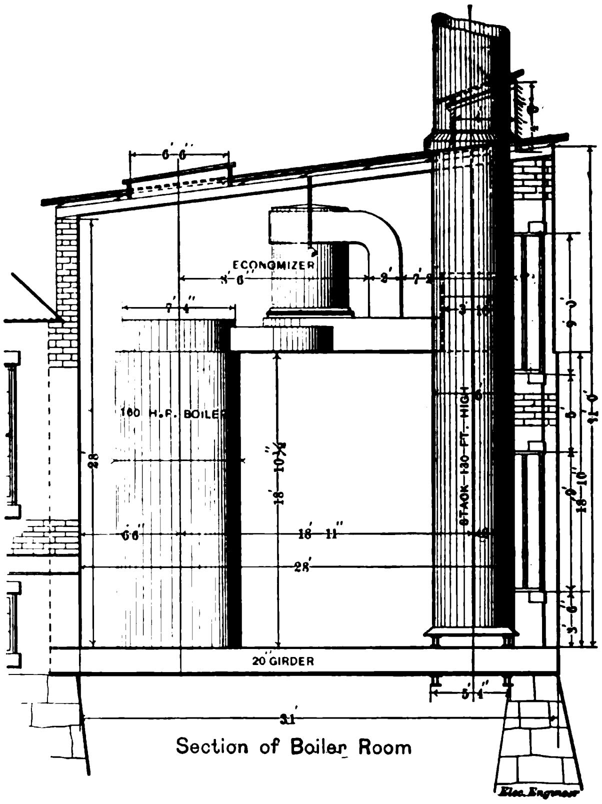


Fig. 3.

This structure consists of eight spans of plate girders alternately 22 feet and 44 feet in length supported on channel iron columns and three spans of Warren girders each 130 feet centre to centre. The deck of the Stony Run viaduct is composed of vulcanized yellow pine ties, as is that of the elevated structure.

THE OVERHEAD LINE.

The railway system is divided into four independent, separate circuits. First, Lexington street circuit; second, North avenuue circuit; third, Cedar avenue circuit; fourth, Lake Roland circuit. The object of this subdivision into separate circuits is to make the different branches of the road as independent as possible from each other. The feed wires for each circuit extend separately and independently from the power station, and, as will be seen from the drawing of the switchboard, Fig. 5, are provided with entirely separate and independent switchboard instruments, so that any circuit may be operated entirely separately from all of the others. At all points of the line where the trolley wires of the different sections come together, circuit breakers are introduced, so that the independence of each circuit is rigidly maintained. All of the trolley wire used is No. 0 hard-drawn copper suspended by Railway Equipment Company insulators. Through the narrow streets of the city span wire construction is used exclusively, the overhead line being supported from heavy iron 6-5-4 inch poles set on either side of the curb stone, the joints being shrunk together and provided with malleable iron splicing pieces. The span wires are all insulated with a breaker at each pole, and are arranged with eye bolts so that the tension of each span may be at any time regulated. The feed wires are carried on the tops of the poles upon wooden pins inserted in special iron pole tops, each pin being insulated by a P P glass insulator to which the feed wire is attached. The wiring of the road is somewhat differently arranged than is frequently customary upon electric roads. The main feeders are nearly all carried to a centre, from which point distributing feeders are run parallel to the trolley wire in both directions. In connection with the overhead line, a rather novel feature of the generators may be mentioned by stating that they are designed to be over-compounded to the extent of about 100 volts. By this means the potential at the terminals of the generator under no load will be adjusted at 500 volts; thus an additional E. M. F. of 100 volts is obtained to counterbalance the fall of potential in the overhead line, and by the arrangement of wiring which has been adopted, the distribution to the trolley wire at any point should not vary over 15 to 20 volts, between no load and full load. This system is now in full operation upon the North avenue circuit and is proving very efficacious. All of the feed wire is of Washburn & Moen manufacture, quadruple grade.

Outside of the narrow city streets centre pole bracket construction is adopted, the poles being 8 inch octagon pine poles. Beyond the end of the double track on North avenue, a double trolley wire is suspended through the entire length of the single track. By this means the use of switches at the turn-outs is avoided.

BUILDINGS.

The buildings for the Lake Roland Elevated Railway will consist of a power station and a car house. The power station is located on the Jones's Falls turnpike road at the intersection of Stony Run with Jones's Falls stream. The car house is located near Wyndhurst avenue in Roland Park. Both of these buildings will be substantial stone structures.

Fig. 1 shows the site selected for the location of the power station. It will be seen that the building is located on the Jones's Falls turnpike at the junction of Stony Run and Jones's Falls stream. This location for the station was selected on account of the cheapness of real estate there to be obtained, the proximity to the tracks of the Northern Central Railway and the Baltimore & Lehigh Railway, enabling coal to be delivered at the station in car loads with no handling, and the unfailing water supply furnished by Stony Run and Jones's Falls, permitting the use of condensing engines and obviating city water bills. From Fig. 1 it will be seen that the ground plan of the building consists of five rooms, a main large room forming the engine-room 93′ by 56′ 6″, a boiler room 28′ by 58′ 6″ and a second boiler-room 21′ 9″ by 58′ 6″; also two small rooms forming a lavatory and oil-house. The larger

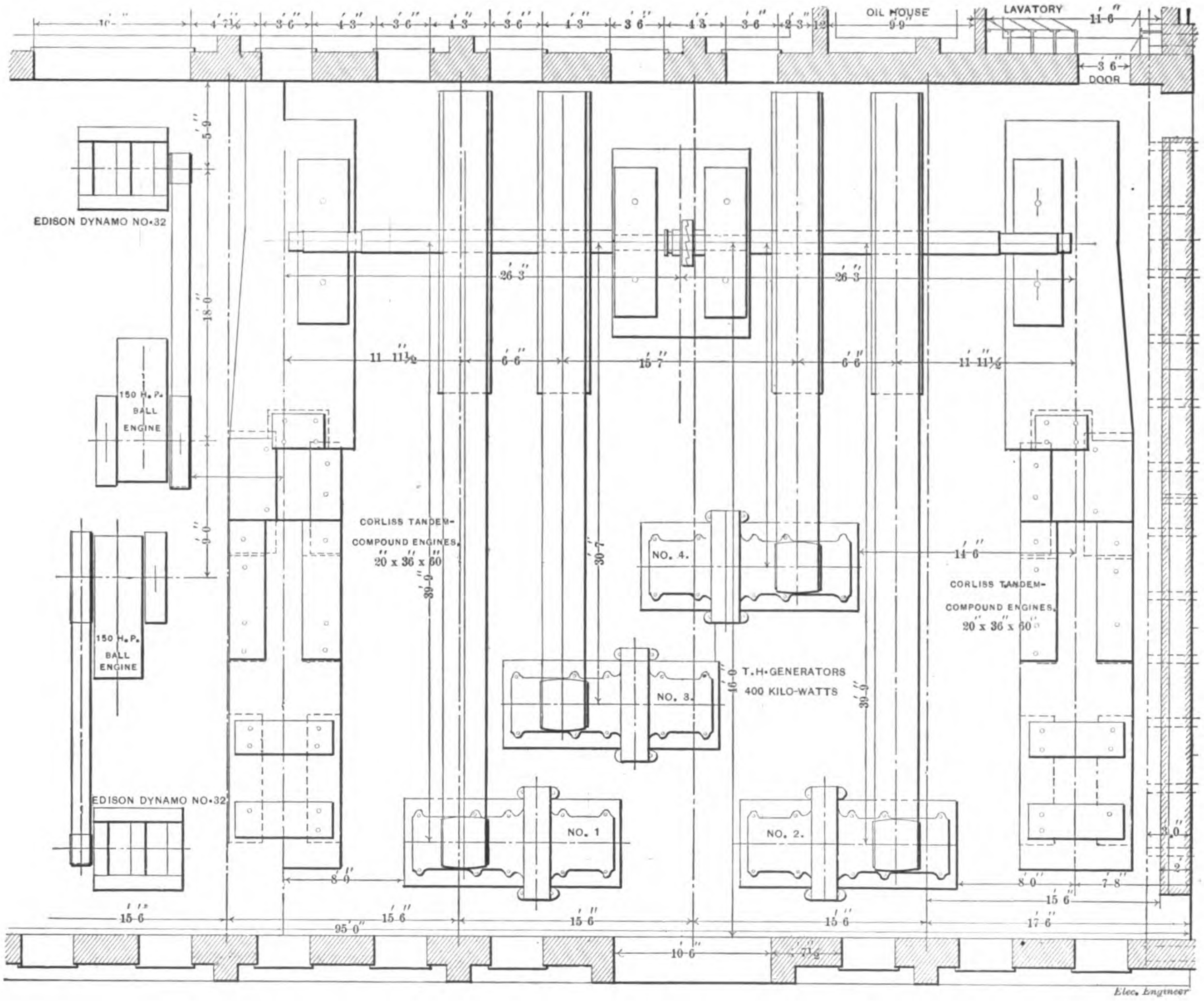


Fig. 4.—Plan of Engine and Dynamo Room, Lake Roland Power House.

of the two boiler-rooms is built directly over Stony Run stream. It will be seen that space is provided for the extension of the engine and boiler-rooms.

The power station is built of what is called Falls Road stone, being a fine grained syenite of very substantial and durable character containing no iron. The walls are 2′ thick with buttresses 12″ by 18″ extending from the ground to the roof level for the purpose of supporting the roof trusses, substantially in accordance with Fig. 2. All the walls are laid up with a mortar composed of Portland cement one part and sand three parts; and by the specifications the stones composing the walls are required to average at least one cubic foot in size.

The engine-room consists of two stories. The basement story is 7′ in height and contains the foundations for the engines and dynamos and all the steam piping of the condensers and feed-water heaters. The main floor of the station is 7½′ above the basement floor, and has access both to the coal track for the reception of machinery and to the Falls road. The main floor of the engine-room is composed of iron eye beams carrying 12″ brick arches covered with 3″ of Portland concrete, the idea being to make the power station absolutely fireproof in every respect.

The roof of the station is built by the Variety Iron Works and consists of iron trusses covered with seam sheet steel. Along the lower chords of the trusses four travelling cranes are provided, one extending over the main shaft, one over the cylinders of the engine and two over the generators. Each of these cranes has a capacity of eight tons, thus providing ample facilities for any repairs. With the exception, therefore, of the window casings and the doors, the station is absolutely fireproof in every respect.

THE STEAM PLANT.

The steam plant, Fig. 4, consists of two tandem compound Corliss engines 20 in., 36 in., 60 in. connected directly together by means of a counter shaft 17 in. in diameter and 52 ft. long. This shaft is divided into two parts, being supported at the centre by two bearings and carrying a jaw clutch so arranged that either half of the shaft can be thrown off at pleasure. On each side of the shaft are two fly-wheels 40 in. face, 20 ft. in diameter, weighing 36,000 lbs. From these fly-wheels belts proceed directly to the pulleys of the Thomson-Houston generators. It is obvious that this arrangement presents one which is at the same time free from complication, and also allows great flexibility in the operation of the station. In case of the disablement of one engine, by opening the connecting rod strap the other engine will be enabled to drive the entire plant; and by opening the clutch at the centre, either engine can operate its two generators entirely independently of the other engine.

The boiler plant consists of six 84 in. vertical Corliss boilers intended to run at 160 lbs. gauge pressure. The boilers are arranged as shown in Fig. 3, in a line along the wall of the boiler-room adjacent to the station. From the tops of the boilers, steam pipes proceed in each direction toward the centre of the engine-room, provided with suitable valves so that either half of the boiler plant may be cut off independently of the other half. Duplicate steam pipes run from the junction down to the basement of the engine-room and thence to the cylinders of the engines, the piping being so arranged that either the high or low pressure cylinder of either engine can be supplied with steam independently of each other. The exhaust piping is also arranged so that the exhaust may be taken from the high pressure cylinder either into the low pressure cylinder through the feed water heater into the condenser or around the condenser into the atmosphere, or around the heater into the condenser, or directly into the air. In the event of accident to the low pressure cylinder, the same arrangements can be made directly from the high pressure cylinder. Thus it will be seen that practically the station is equipped with four independent cylinders, each capable of being operated in any manner separately and distinctly from any one of the other cylinders. In order to attain a maximum steam economy, a large heater is provided for each engine, which takes the overflow from the condenser, and after raising the temperature by means of exhaust steam, forces the feed water through two economizers composed of brass tubes placed in the uptakes from the boilers. By this arrangement the feed water is given a temperature of

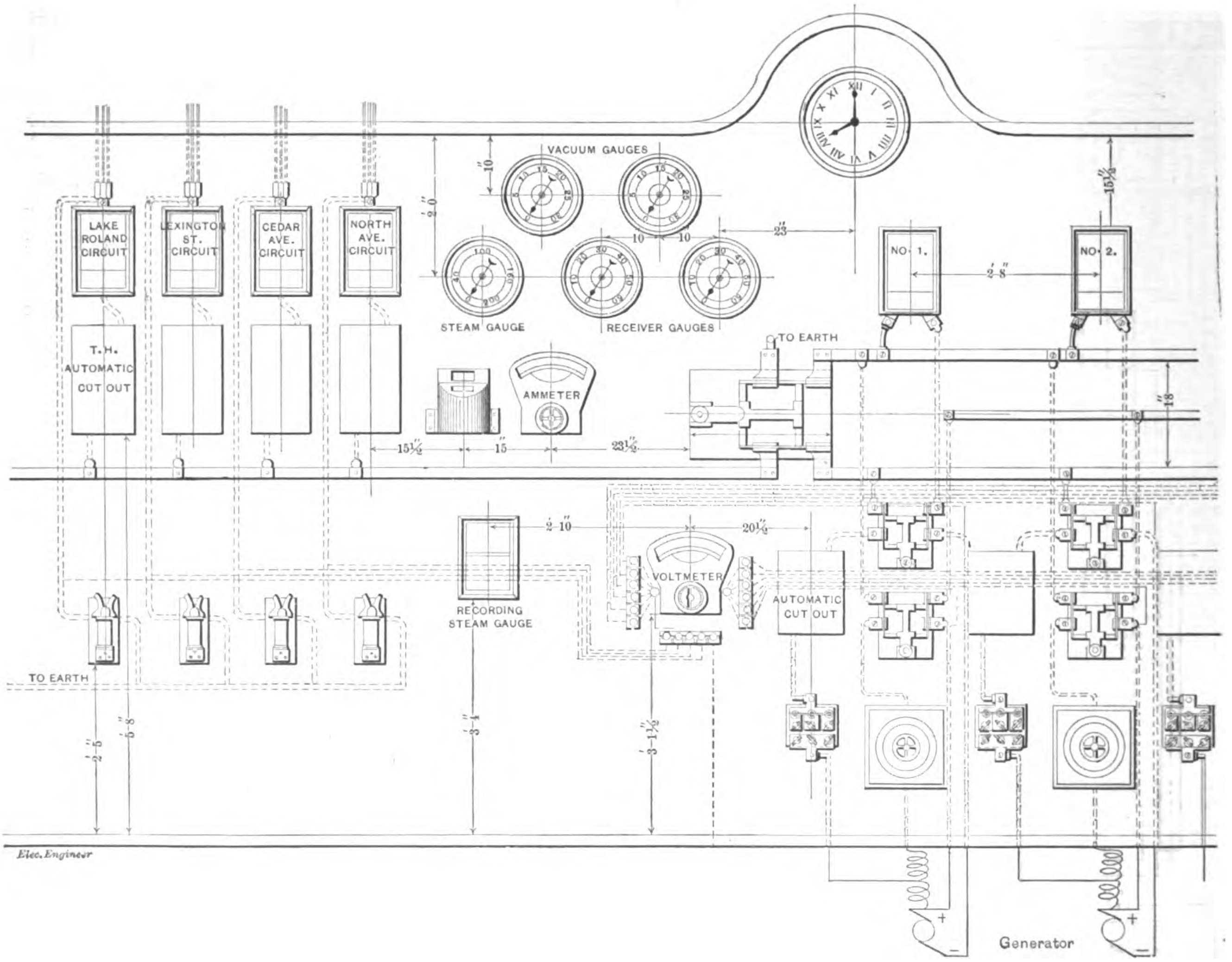


FIG. 5.—ARRANGEMENT OF STATION SWITCH BOARD, LAKE ROLAND ELECTRIC RAILWAY.

about 200° previously to entering the boilers. The feed water is primarily controlled by a directly connected air pump and the condensers to the engines. An auxiliary steam pump and two sets of injectors are also provided so as to obviate any possibility of failure of the feed water supply. All of the feed water, previously to entering the boilers, is passed through a Union water meter provided with thermometers, so that quantity and temperature is constantly measured.

ELECTRICAL EQUIPMENT OF THE STATION.

The electrical equipment of the station consists of four 400 k. w. Thomson-Houston machines of the latest type, especially designed and built for the Lake Roland Road, so as to be over-compounded to the extent of about 100 volts. This over-compounding is controlled by means of a shunt placed around the series coils of each machine, so that the amount of compounding can be varied at pleasure from a plain shunt machine to an over-compounding of 25 per cent. of the generator's normal pressure. These machines are of the four-pole type and show a remarkably small amount of magnetic leakage. In addition, two No. 32 Edison bi-polar generators are placed in the station, being driven by two 150 h. p. condensing Ball engines. It is expected that this small generator plant will be capable of taking care of the service between midnight and six o'clock a. m.

The switchboard, Fig. 5, consists of a large board of polished oak set two feet from the south wall of the station. The board is practically divided into two parts, the left-hand half being arranged for the accommodation of the separate circuits, while the right-hand half is provided for the generators and their apparatus. The four circuits comprising the overhead line of the road are at the top of the board. Here each circuit is provided with its own independent ammeter, automatic cut-out and lightning arrester. From the automatic cut-out the positive bus bar runs toward the right, and is supplied with a main ammeter and a wattmeter and a main double-pole switch. The automatic cut-outs and lightning arresters are of the well-known Thomson-Houston type. The main ammeter and voltmeter are of the new Weston station type, while the wattmeter is a 200 ampere Thomson-Houston instrument, operated in a shunt from the positive bar. The voltmeter is so arranged that it may be connected with the poles of either one of the generators with the generator and the ground, or with either circuit and the ground, at pleasure. By this means a constant supervision may be had over the voltage and insulation of the generators, and the circuits and the conductivity of the latter. On the left-hand side of the board the positive, negative and neutral bus bar are placed, all being of solid copper rod so proportioned that the current does not exceed 1,000 amperes per square inch of copper section. Each of the generators is provided with an ammeter, an automatic cut-out, a triple fuse block, a rheostat for controlling the shunt circuit and two double-pole switches. By following the wiring diagram shown on the switchboard, it will be perceived that the shunt circuit of each of the generaters is not excited by the generator itself, but directly from the bus bars on the switchboard. By this means any tendency to production of unequal voltages in the several machines is entirely avoided; and, consequently, no generator can reverse any other machine and drive it as a motor. The difficulty of running machines in parallel is also largely avoided, it being simply essential in order to get any idle machine into the circuit to get the armature up to speed and close the appropriate switches.

CAR HOUSE.

The car house is a substantial stone building constructed under the same specifications as applied to the power station, and is 204 feet long by 108 feet wide. It is provided with eight tracks, and is capable of accommodating some seventy-five cars. In the southeast corner of the building an office has been provided for the transaction of the company's business, an ample repair shop fully equipped with all tools necessary for street railway repairing, a storeroom, a repair track with four ton traveling cranes and wash track for cleaning cars.

CAR AND MOTOR EQUIPMENT.

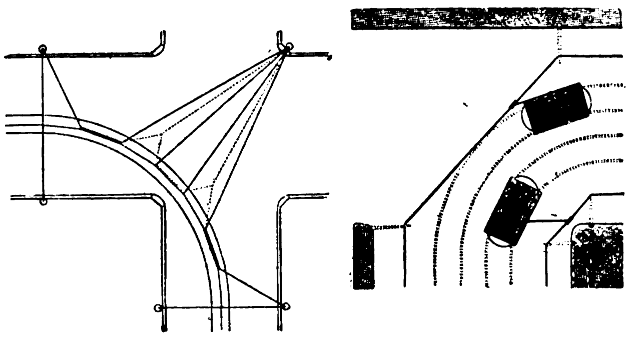
The present car equipment of the road consists of four 16 feet vestibule-end closed cars and three 16 feet open cars. These cars are equipped with four Baxter motors and two Westinghouse motors. The new equipment will consist of twenty-five 33 feet Pullman cars with 33-inch wheels and McGuire trucks. These cars will be equipped with two 30 h. p. single reduction Edison No. 16 motors with series-parallel controlling stands. In the early spring it is the intention to add to this equipment fifteen trail cars to accommodate the excursion travel between Baltimore and Lake Roland.

Eickemeyer-Field Motors.—After an exhaustive test of about six months on the tracks of the Street Railway Company of Steinway, L. I., of the Eickemeyer-Field Mfg. Company's electric railway system, the directors have decided to adopt this system.

THE OVERHEAD CONSTRUCTION OF THE SOUTH STAFFORDSHIRE TRAMWAYS.

In order to simplify the overhead construction of roads having many curves, the management of the South Staffordshire Tramways have adopted a method employing a radial trolley pole and doing away with span wires. The trolley wire is simply suspended upon arms projecting from two to five feet from steel columns about 21 feet above the roadway. The arms are stayed by steel bands. No matter how sharp the curves, no guy wires are employed, the columns being especially designed to withstand severe strains. The whole system depends upon the flexibility of the trolley arm, or, as it is here called, the side collector, which automatically engages the trolley wire in any position from two to twelve feet from the side of the car.

The accompanying diagrams, reproduced from the pages of the London *Electrical Review*, show the radical departure of this system from that in ordinary use. The trolley arm is made of metal, with a ball and socket arrangement, and it revolves on a metal rod placed within in a tube. It is controlled by springs fixed to a loose collar which works on the pedestal of the ball socket. The trolley is hinged to the arm to permit lateral play in any direction and was originally provided with guides. It was found, however, that these were unnecessary, as the trolley guides itself without difficulty.



American and English Trolley Wire Suspension.

ELECTRIC RAILWAY DEVELOPMENT AT TROY, N. Y.

The recent consolidation of the Troy and Lansingburgh Rail Road and the Troy City Rail Road (formerly the Troy & Albia Rail Road) has resulted in the resignation of James O'Neil as president and the election of Chas. Cleminshaw, Esq., to the position. Mr. Cleminshaw formerly held the position in both the Troy City and the Troy & Lansingburgh Roads, but resigned from the Troy City, as he was unable to give proper attention to both roads, and to his immense business interests in addition. The roads now being consolidated, and under one and the same management, the election is considered by his friends as a gratifying endorsement of his ability in managing railway interests in this section. The capital stock of the Troy City Railway Company has been increased from $400,000, to $2,000,000, divided into 20,000 shares of $100 each, and certificate filed with the Secretary of State, endorsed with the approval of the State Rail Road Commissioners. This increase of stock was voted at a recent meeting of the stockholders. The company's debts and liabilities, including the debts and liabilities of the Troy & Lansingburgh Rail Road, which were assumed by the Troy City Rail Road, amount to $739,984. The directors of the company are as follows: James O Neil, William Kemp, Edward Murphy, Jr., Chas. Cleminshaw, Anthony N. Brady, Peter McCarthy, E. Ogden Ross, and Joseph J. Hagan. The increase of stock is desired for the purpose of providing funds for the extension of lines, and also to meet the expense of changing the motive power of the road to the overhead trolley system.

The company has recently placed two new dynamos in the Division street station, and is now amply equipped for all emergencies, using the Lansingburgh station as an auxiliary source of power. The company are placing new cars on the road as fast as required, four having been received from the shops recently. The electric system at the present time is complete with the exception of the branch to Cohoes via Green Island, known as the "White Line," which is still operated by horses. It is stated that the obstacle in the way of equipping this line with electric power is the Delaware and Hudson Rail Road Co. contract, made many years ago, and under which provisions were made for running horse cars over the bridge. The Delaware and Hudson Co., it is stated, consider this contract disadvantageous to its interests, and refuse to renew on the same terms for the electric cars; but it is expected that by next spring a new contract will be drafted.

THE GENERAL ELECTRIC PANEL SWITCHBOARD.

THE General Electric Company in designing the railway power switchboard shown in the accompanying illustrations, had in view a board to which additions could be readily made as the capacity of the plant was increased, and accordingly adopted the panel construction. The panels are 62 inches high by 24 inches wide and are made for four capacities: 200, 400, 600 and 1,000 amperes. They are all exactly similar and a board may therefore be made up of panels of different capacities and yet be perfectly uniform in appearance. It is also possible to change the positions of the individual panels without alteration. They are fastened together by bolts at the back.

On the front of each panel, Fig. 1, may be seen the automatic circuit breaker with a resetting device for use when two or more panels are connected to guard against an undue load being thrown upon one generator. Below this is a Thomson-Houston current indicator lighted by a bracket lamp, and below this, again, is seen the handle of the rheostat. To the right of this is a flash lamp connected in series with five lamps on the rheostat, and on the left is the field circuit switch of the generator. Below are the triple pole main switch, the small double pole switch, connecting the bus-wires for the lighting circuit with the generator leads between the generator and the main switch, and the voltmeter and socket.

The back view of the panel is shown in Fig. 2. The negative bus-bar is at the top, the positive directly below it, and the equalizer bar at the bottom, while between the last two is the rheostat. The magnetic cut-out for the voltmeter circuit and the main circuit lightning arrester are in the lower right hand corner, and that for the lighting circuit in the right hand corner. The connections on the panel are complete and when installing the board it is only necessary to connect the three main leads, the two feed wires from the generators and the necessary ground and line feeder wires.

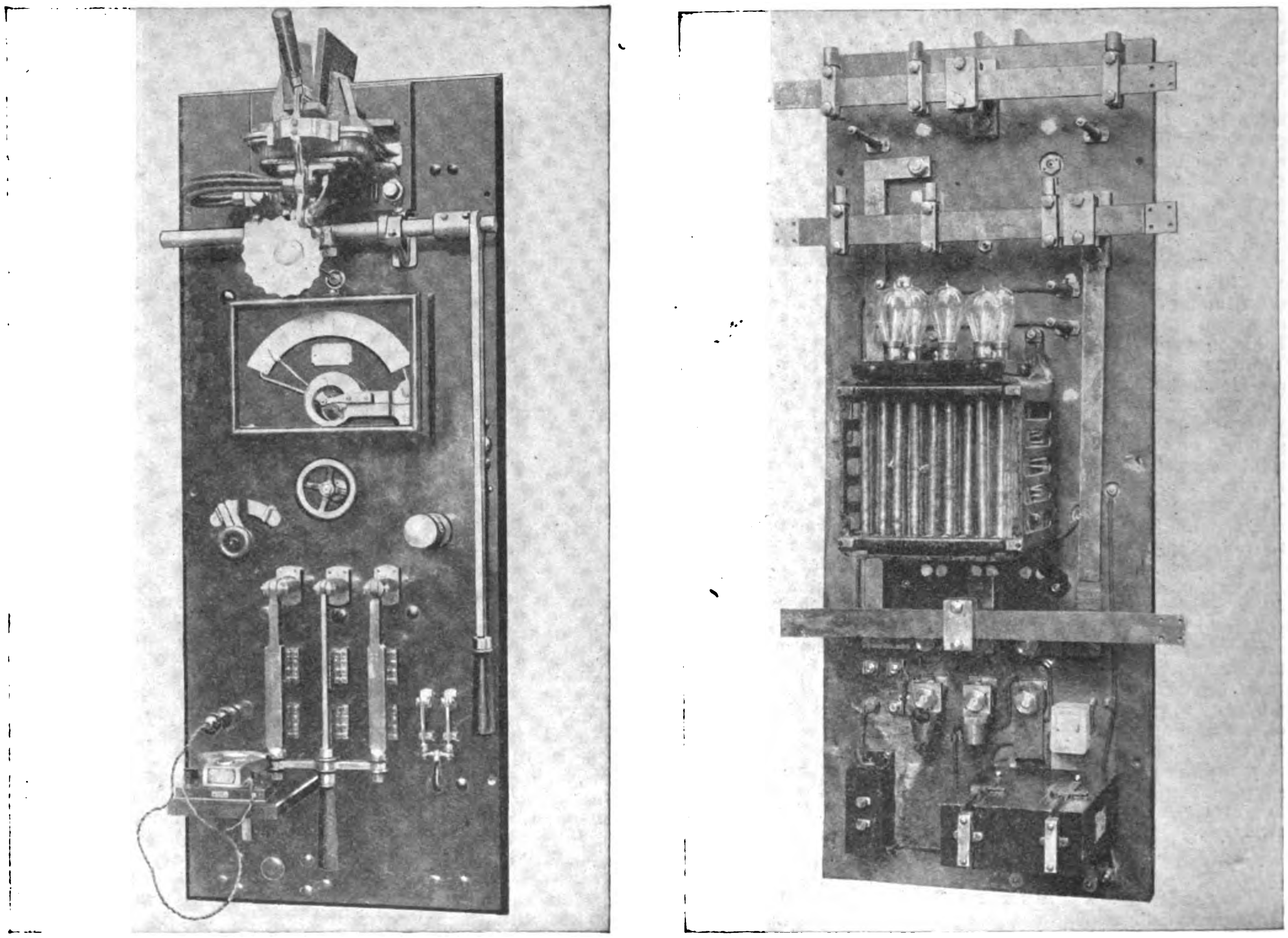


FIG. 1 AND 2.—THE NEW GENERAL ELECTRIC RAILWAY PANEL SWITCH-BOARD.

HIGH-SPEED RAILWAY IN AUSTRIA.

AN interesting lecture was recently delivered in Vienna, at the society of Austrian engineers and architects, by M. Hugo Kostler. The subject was the proposed electric railway for rapid communication between Vienna and Budapest. According to this project, an electric railway would run on the right bank of the Danube at the high speed of 120 miles an hour, thus reducing the journey between the two capitals from five hours to one hour and a half. The distance between Vienna and Paris, which is now covered in 26 hours, would then only require seven hours, and that between Paris and Constantinople would only take 15 hours instead of 65. The trains would have a single car containing 40 passengers, and could be dispatched at intervals of 10 minutes. The differences of grade being taken into account, an electric motor of 200 h. p. would be necessary for each car. It is stated that arrangements are being made to test this system between two important centres.

THE DEMAND FOR ELECTRIC STREET CARS.

IT is predicted by Gen. Horace Porter, vice-president of the Pullman Car Co., and others, that 1893 is to be an active year for electric car building. He says: "A highly important factor in creating the present boom is the fact of so many street car companies, all over the country changing their motive power from horses to electricity or cable, but I believe very largely to electricity. It is surprising the extent to which this change is being made, as indicated by the orders for new cars. Of course such a change necessitates re-equipping the road with cars, and you will readily see that this means a vast amount of car building and rebuilding."

"It is really remarkable," said the agent of one prominent company, "the extent to which electricity seems to be coming into use as a street car motive power. It was predicted that this year would be the biggest yet known in electric car building. It has proved so, but the indications are that next year's output will largely exceed it. We have had to build another plant, almost doubling the size of our works, exclusively for building cars for electric street railroads. And I know this has been the case with several companies. Not only is electricity coming largely into use on old roads, but the growth of street car systems in towns and short railroads connecting towns and villages, has increased at a surprising rate since electricity began to take its place as a practical means of railroad traction, and there is, of course, a corresponding increase in the car building business. Electricity seems to be increasing traveling facilities and conveniences at a greater ratio even than it is superseding old methods of traction."

PERSONAL.

HARVEY L. LUFKIN.

MR. H. L. LUFKIN, who has just become associated with the Crocker-Wheeler Electric Motor Company as Manager, has had a long connection with electrical work, and with more than one branch of the industry. Some early experiments of his in the then new field of long distance telephony covered all the New England territory in 1883-4 and were afterwards carried as far as Cleveland, Ohio, using the Gray Postal steel core, copper plated wire. In 1885 Mr. Lufkin went to Central America to push some government concessions in which he was interested, and while at Trujillo he found a set of Bell instruments, sent out to the authorities, who had been unable to set them up for want of knowledge. Mr. Lufkin at once put up a circuit—the first in the Republic of Honduras—which worked so well that in order to avoid becoming president of the Republic by acclamation, at the next revolution, Mr. Lufkin returned to this country, leaving a great many disappointed admirers behind him.

Arriving in New York in 1886, Mr. Lufkin, who had meantime kept himself informed of the advances in electrical work, became interested in the C. & C. Electric Motor Company, soon after its original incorporation, and nearly all its early motors were installed by him or under his supervision. The exhibition made by him of C. & C. motors at the Philadelphia meeting of the N. E. L. A. in February, 1887, was the first of its kind, and did great good in many ways, while the growth since that time of the exhibition feature of these conventions has become matter of history. Before the same Association at New York, in August, 1888, Mr. Lufkin read a most valuable and interesting paper on "A Basis from which to calculate charges for Electric Motor Service." This was of a theoretical nature and was followed up by a practical paper read at the Cape May meeting in August, 1890. Both papers are standard reading to this day.

In the field of factory power transmission, Mr. Lufkin is a pioneer. The first complete electrical power plant on record was the fine one installed in the C. & C. factory, and beyond that are many others, of later date, including the Fraser & Chalmers at Chicago, which is the largest of its kind, and was also laid out by Mr. Lufkin. Several important mining installations are also due to his energy and ability, among them being the Belmont Consolidated; the Sheridan & Mendota; and the Helena & Livingston, all of them most interesting examples of electric power work. In the development of this line of engineering, Mr. Lufkin has made a close personal study of the mining conditions of the West, and he is therefore remarkably well informed on this new and difficult branch of the subject.

Mr. Lufkin is not yet in the prime of life, but with so much experience and so high a reputation, he may safely be counted upon to distinguish himself in his new relationship and to confer further benefits upon the growing electrical power industry which has already seen so much of his intelligent work.

WILLIAM S. HINE.

MR. WILLIAM S. HINE, formerly General District Agent, of the Westinghouse Electric and Mfg. Company in this city, has assumed the general sales-management of the J. T. Case Engine Company, of New Britain, Conn. The Case engine, which many of our readers will know of as an oscillating engine, has already attracted considerable attention from the novelty of its construction and its peculiar adaptability to small electric stations and isolated plants. The company is to be congratulated on having secured the services of Mr. Hine in pushing its introduction especially into the field of electric lighting, in which he has had so wide an experience.

MR. FRED. DELAND, who for some years past has been the Western manager for the W. J. Johnston Company, Ltd., and the representative of *The Electrical World*, has resigned his position and will hereafter have no connection whatever with the concern. Mr. DeLand, who is a graceful writer, will become the World's Fair correspondent of the *Scientific American*. His long years of faithful service have won him many friends in technical and industrial circles, and he will now have an excellent opportunity to do good work and derive some benefit from it. Mr. DeLand will also conduct a monthly paper called *World's Fair Electrical Engineering*.

LETTERS TO THE EDITOR.

THE LIGHT THAT SHOULD NOT BE ON TROLLEY LINES.

THERE is a matter of importance that I desire to call attention to and which has not received the consideration deserved. It is in regard to arc lighting on electric railways. There is a company that advertises in the various electrical journals an arc light, stating that it can be used 10 in series on 500 volt circuits. I consider their lamp a good one, but this is not the light I refer to, but to the one in series on top of the car—the arc between a defective trolley wheel and the wire.

Why railway companies continue to illuminate their routes in this manner, I cannot conceive when the first-named system would be preferable by reason of its economy, better distribution of light, and the safety of the public in general. I have noticed numbers of times melted metal drop from the trolley to the top of car and the ground below.

If trolley poles were properly attended to when out of adjustment, and if eccentric or defective trolley wheels were removed when necessary and trued up or new ones substituted, it would make the poor overworked motor beneath the car—I have heard its groans and shrieks of agony—put on the seraphic smile supposed to be worn only by angels when having their photographs taken for a Sunday-school picture.

X. I. M.

ANOTHER "ELECTRICAL FIRE" NAILED.

IT was reported by the morning papers of November 30th, that a fire had been caused by electricity at the *Mail and Express* building, 203 Broadway, where the offices of THE ELECTRICAL ENGINEER are located.

As per your request I made an inspection of the premises in company with the underwriters' expert, and no evidence was found that could attribute the cause of the fire as coming from the electric light wires. The true cause of the fire was from what is known as a gas pocket under the floor; said pocket being an accumulation of gas which had escaped from an imperfect joint at the base of the fixture.

The underwriters' expert ascertained that there had been for some time a general complaint throughout the building in regard to escaping gas, and all the evidence which was obtained from the people in charge showed conclusively that the fire was caused by this pocket of gas igniting at the base of the fixture, and setting fire to the floor above.

I trust that this report will be of some assistance to you, and hope that your valuable journal will deny specifically that the fire was caused from faulty electric lighting.

INSURANCE EXPERT.

NEW YORK CITY, DEC. 1, 1892.

DO LINES OF FORCE ROTATE WITH AN IRON CORE?

PLEASE allow me to ask a question concerning a statement which Mr. Edward C. Boynton, Jr., M. E., makes in his paper "On Unipolar Dynamo Construction," published in your esteemed journal of Nov. 16, 1892. The statement is as follows:

"If the core of a bar magnet be rotated about its longitudinal axis, no matter whether the energizing coil be rotated with it or not, the lines of force are practically stationary and do not rotate with the core."

The question I wish to ask is this: Can the author describe some experiments, his own or somebody's else, which prove directly the correctness of his statement? I do not remember having seen anywhere a direct experimental proof of that statement and therefore conclude that the proof, if it exists at all, is not known quite as well as it deserves to be.

M. I. PUPIN.

NEW YORK, NOV. 22, 1892.

"A PLEASURABLE TASK."

ON Wednesday THE ELECTRICAL ENGINEER, of this city, gave a house warming which was largely attended by engineers, journalists and business men, who were glad to offer their congratulations upon the prosperity of the paper and the comfort and convenience with which it is housed. Last April this journal moved into its present quarters in the *Mail and Express* building, 203 Broadway, New York, where its offices now occupy the entire eighth story of the Fulton street wing, covering a floor space of 2,060 square feet. Messrs. Phelps, Colvin, Martin and Wetzler on this occasion had an opportunity to show what adepts they were in dispensing hospitality and it is needless to say they proved themselves equal to the pleasurable task. An elaborate luncheon was served.—*Western Electrician.*

MISCELLANEOUS.

THE USE OF COMPOUND WOUND GENERATORS FROM A PRACTICAL POINT OF VIEW.[1]

BY M. WILLIS.

In all electric installations, whether for incandescent lighting or power transmission, the first requirement is that the dynamo or dynamos shall maintain a constant potential difference at the brushes or at some distant point. On examination we find that the shunt machine by armature reaction alone as a single factor, not to mention the host of other factors,'is unable, in practice or theory, to fill the before-mentioned requirement, viz., to keep a constant potential difference at any point predetermined without hand regulation or some form of governing device, such as an automatic rheostat, for instance. The requirements are the most nearly reached by the compound machine, the E. M. F. of which keeps constant or increases directly as the load on the machine increases.

We find in the building of compound machines that certain conditions are assumed. In the first place we find that the speed of the machine is assumed constant. This of course introduces a slight source of error, as in practice, in a large percentage of cases, more especially small plants, the speed varies at least 2 per cent. This does not take into consideration the creepage of dynamo belts, which amounts to from 1¼ to 2½ per cent. by actual experiment, not to mention belt slippage. All these factors of course increase in direct proportion to the load. In railway practice and in the transmission of power a few per cent. variation is, however, permissible. It would seem advisable to over-compound even railway generators to a slight extent to make up for small variations of speed. This may be accomplished in some machines without special winding, as, for instance, by carrying the length of a German silver shunt used to shunt a portion of the main current past the series coils and thus allow a larger proportion of main current to flow through the series coils of the machine.

We will now consider the use of the compound and over-compound machines under various conditions. Taking the case of a compound wound machine running singly, we find that its series winding may be constructed with such a number of turns that it will practically compensate automatically from no load to full load; for all internal reactions, such a machine is evidently eminently fitted for railway and similar work, as it will maintain a practically constant potential at the generating station.

The next case is one in which we have an over-compounded generator, running singly, and we find that its series coils, if correctly constructed, will fairly compensate for internal reactions and also for the varying percentage of loss in line, all of which will vary directly with the current. A machine of this class and under these circumstances would be admirably fitted for incandescent lighting and transmission of power, and more highly fitted for railroad work than a straight compound machine.

The next case is one in which we have two compound wound machines running on the three wire-system. Their series windings will compensate for internal reactions and thus keep the potential at generating station constant, even if the system becomes unbalanced, as the excess load on one side above another would pass through the series coils of the more heavily loaded machine and increase its magnetic field, thus keeping its potential at a level with the more lightly loaded machine. Under similar conditions, of course, a shunt machine would lower its potential.

The next case is one in which we have two over-compounded machines running on the three-wire system, and one finds that, however unbalanced the load may be, both machines will maintain a practically constant potential at any predetermined point if the compounding is correctly figured; 110 volt dynamos of such a type and under such circumstances would be the correct thing for incandescent lighting where the distance of lamps from the generating station does not exceed one-half mile, where the cost of conductors on the 110 volt system and the cost of transformers on the alternating system would make these systems too expensive in comparison with the 220 volt system.

Another case is one in which we have compound wound generators running in multiple on the two-wire multiple arc system. We find that the generators will compensate for internal reactions but will not compensate for loss in transmission. Machines of this form and running in multiple would be but little better than straight shunt machines. One of the only advantages is that they would divide the total load among them more equally than shunt machines would under similar conditions.

Finally we have a case in which we have over-compounded generators running in multiple. The series winding will fairly compensate in the average manufacturer's machine for internal reactions due to varying load and also when all machines are running for all variations in loss in the system due to varying load. It is this form and arrangement of generators for incandescent lighting which is at present rightly popular for isolated plants.

The author then assumed a case in which an arrangement of over-compounded machines in multiple will not maintain a constant potential at the lamps, namely, when two or more compound machines are run in multiple, and all are cut out but one. In doing this it would be found that the voltage at the lamps would increase considerably, for the reason that when at full load, with all machines running, the loss is 10 per cent. in feeders and the voltage of lamps correct. When we cut out all machines but one, say, then the total current which was previously divided among all machines will be drawn from the remaining one, and, in consequence, will pass through its series coils and thus raise the voltage at the lamps, because the percentage of loss in feeders has varied from 10 per cent. to the percentage of loss at, say, one-third load. This case may prove very serious with 110 volt lamps. On two-wire multiple arc systems, for instance, the voltage at lamps would vary from 110 volts to at least 118 volts. Of course, in this case hand regulation with ordinary generators would have to be resorted to, and the only benefit derived from the compound winding would be the accurate division of load between compound wound generators running in multiple and the practically automatic regulation obtained for varying loads with all machines running.

A solution of the problem of how to keep voltage at lamps down when all machines but one, say, are cut out, would be to either wind the series coils in sections and, when machines are thrown out, to short circuit a certain portion of each of the series coils of the rest of the generators, or to operate a shunt of variable resistance, which shunt would cut down current flowing through the series coils in direct proportion to the number of machines cut out. In addition to this it would also be advisable to excite the shunt field spools of all machines from a separate exciter, run from an independent source of power from that which runs the generators themselves.

One finds in practice that few compound machines will maintain within one per cent. constant potential at any predetermined point, as a factor will creep in which it is almost impossible to provide for in the compound winding, and that is the heating up of the machine, which depends on the ventilation of the machine itself, on the ventilation of the dynamo room, and also on the temperature of the outside air. It might be said that in general too much is expected of a compound or over-compounded machine and too few allowances are made.

THE MAGNETIC FIELD.[1]

BY PROF. E. J. HOUSTON.

PROF. HOUSTON opened his remarks by the definition of the magnetic field, and described the curious properties possessed by that field, which he summarized under three heads. The lecturer next referred to the lodestone, pointing out how this ore and its magnetic powers were known to the ancient Chinese, Greeks and Romans. He gave quotations from various authorities, giving the name in several languages, given to the lodestone. Prof. Houston then spoke of the directive power of the magnet, and drew attention to the fact that the Chinese were aware of it and steered vessels by it about 2,000 years before Christ; while a magnetic needle in the shape of a mariner's compass was known to the Syrians about 1242. The lecturer mentioned the writings of Robert Boyle about the year 1668, then spoke of the widespread though erroneous impression that the north end of a magnetized needle pointed to the exact north pole of the earth; there was always a varying deviation to the east or west of the true geographical north, except at very long intervals of time. A dipping needle was exhibited, showing that a magnetized body was not only attracted in a horizontal but in a vertical plane.

Prof. Houston then referred to Faraday as the father of the modern science of electricity, and held that one of his greatest merits was to deny the possibility of magnetic action through space independent of some medium; this led to the theory of the magnetic field, and the conception of lines of force through surrounding space, leaving the magnet at one end and returning at the other.

He showed the field of a magnet by using both iron filings and nails, and followed that by lantern slides showing the fields formed by horseshoe magnets, the opposing poles and the attracting poles of magnets. A very good method of photographing the lines of force was then shown, the process being that already described and illustrated in THE ELECTRICAL ENGINEER.

It was shown that bodies suspended in the field of a magnet became in time magnets of themselves. Experiments were made to demonstrate this. A resemblance was drawn between electric and magnetic flow, as to source of energy, conductors and receptive devices. Prof. Houston spoke of Oersted's discoveries, and discussed the theories of Hughes and Ewing. In closing,

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[1] Abstract of a paper read before the Chicago Electric Club, November 21, 1892.

[1] Abstract of a lecture delivered before the N. Y. Electrical Society, at Columbia College, Dec. 1, 1892.

Prof. Houston showed how the earth was a huge magnet, the lines of force coming from the south where the north magnetic pole is agreed to lie, passing through the air surrounding the earth and re-entering the south magnetic pole in the northern hemisphere. It follows that magnetic needles in this field will have the lines of force threading through them because of the permeability of the body, thus directing the pointing of the needle according to the direction of the earth's lines. Prof. Houston spoke in high terms of Mr. Nikola Tesla and his work, and concluded with the belief that the time would come when photographs could actually be taken of the lines of magnetic force.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED NOVEMBER 22, 1892.

Alarm and Signals :—

Electric Signaling Device, J. J. Ross, Detroit, Mich., 486,569. Filed Dec. 29, 1891.

A signaling apparatus automatically operated by a moving train.

System of Railway Signaling, T. A. Edison, Menlo Park, N. J., and E. T. Gilliland, Boston, 486,634. Filed April 7, 1885.

Relates to apparatus for electric signaling between a fixed station and a moving train by induction.

Pneumatic Fire Alarm, A. A. Lehmann, Baltimore, Md., 486,675. Filed Feb. 1, 1892.

Employs a pneumatic device for closing a normally open electric alarm circuit.

Successive Non-Interference Signal Box, W. E. Decrow, Boston, Mass., 486,702. Filed July 25, 1890.

Consists of devices by means of which, if one or more boxes are released while others in the same circuit are liberated, there will be no confusion, and the liberated boxes will transmit their signals successively.

Electrical Hose Signaling Apparatus, W. Fowler, Colorado Springs, Col., 486,807. Filed Feb. 8, 1892.

Electrical Annunciator, F. S. Carter, Burlington, N. J., 486,820. Filed June 4, 1892.

Employs a dial having pointers pivotally attached thereto and intercepting-pins collectively moved by an electro-magnet.

Dynamos and Motors :—

Dynamo-Electric Machine, G. Baehr, Brooklyn, N. Y., 486,524. Filed Dec. 18, 1891.

Employs a field magnet so constructed as to prevent the stoppage of the machine in case some of the coils should be destroyed, and an armature and commutator so constructed as to bring the two as close together as possible, and make the machine compact, and also provides a simple way of supporting the armature upon the shaft.

Lamps and Appurtenances :—

Incandescent Electric Lamp, G. A. Frei, Springfield, Mass., 486,457. Filed March 14, 1892.

Claim: In an incandescent electric lamp, leading in or circuit wires, an incandescent filament, a joint for uniting said filament and said circuit wires, consisting of a single tube, one end of which receives an end of the filament and is thereto secured, and the opposite end thereof receives an end of the leading in wires and is fused thereto.

Carbon-Brush Holder for Dynamo Electric Machines and Motors, J. J. Wood, Ft. Wayne, Ind., 486,656. Filed May 3, 1892.

Electric Arc Lamp, W. C. Meissner, Chicago, Ill., 486,488. Filed April 15, 1892.

Employs a shaft having two pinions which engage the carbon rod racks, two oppositely faced ratchet-wheels, two dogs on the ends of the pinion cross-bar, and means for running such cross-bar so that the racks are engaged and move in either direction.

Suspension Device for Incandescent Lamps, S. Porter, Boston, Mass., 486,604. Filed Nov. 23, 1891.

Electric Lamp Shade, C. J. Miller, Philadelphia, Pa., 486,729. Filed April 21, 1892.

Electric Arc Lamp, J. Brockie, London, Eng., 486.757. Filed Aug. 6, 1891.

Employs two solenoids, one having a coil of coarse wire in the lamp circuit, and an integral core linked to one arm of the lever, the other having a coil of fine wire in shunt to the lamp circuit and a divided core, part of which is linked to the opposite arm of said lever, the latter being linked to the carbon feeding device.

Measurement :—

Electrical Measuring Instrument, E. Weston, Newark, N. J., 486,689. Filed June 4, 1891.

Employs two magnets relatively arranged to produce an annular field of force, a conductor in loop form rotating in said field, and a spring opposing the movement of said conductor.

Metal Working :—

Electrical Method of an Apparatus for Forming Tubes, G. D. Burton, Boston, and E. E. Angell, Somerville, Mass., 486,624. Filed Sept. 16, 1891.

Relates to a method and mechanism for heating and coiling bars into tubes by electricity.

Electric Metal Heating Apparatus, G. D. Burton, Boston, Mass., 486,625. Filed Oct. 21, 1891.

Relates to mechanism for electrically heating metals preparatory to forging.

Electric Forging Apparatus, G. D. Burton, Boston, and E. E. Angell, Somerville, Mass., 486,626. Filed Jan. 13, 1892.

Has for its object to provide an automatic feed for the bar to be heated, heating the moving section to a forging temperature and shaping it to the desired form ; all the operations being accomplished electrically.

Electric Forge, G. D. Burton, Boston, and E. E. Angell, Somerville, Mass., 486,627. Filed Jan. 13, 1892.

Employs a converter provided with exterior rings constituting opposite poles, conducting brackets attached to the rings, arms connected with the brackets, and clamps having laterally extending jaws carried by the arms for the purpose of heating sheets of metal for forging.

Electrical Metal Working Apparatus, G. D. Burton, Boston, Mass., 486,816. Filed Oct. 26, 1891.

Employs a converter provided with two exterior rings of opposite polarity having conducting arms attached upon which are mounted electrodes provided with contact rolls.

Miscellaneous:—

Lightning Arrester, H. G. Osburn, Chicago, Ill., 486,498. Filed Dec. 26, 1891.

Employs a generator receiver providing a normally closed path connected to the circuit, and having a ground connection and adapted to produce a current of sufficient E. M. F. to counteract the current in the charged circuit.

Process of Electrically Reducing Refractory Compounds, T. L. Willson Leaksville, N. C., 486,575. Filed April 20, 1892.

Process consists in first impregnating a pulverized metallic compound with a reducing agent by saturating it therewith while the latter is in a liquid condition, and then subjecting the whole to the heating action of an electric current.

Apparatus for Recording Speech or Other Sounds, W. Bruening, East Orange, N. J., 486,603. Filed July 23, 1891.

Electric Releasing Device, W. R. Hewitt, San Francisco, Cal., 486,612. Filed Aug. 23, 1892.

An electro-magnetic releasing device for hitched animals.

Current Director, J. F. McElroy, Albany, N. Y., 486,643. Filed Jan. 2, 1892.

Employs a divided circuit, a revolving armature, a fixed portion with which the armature coincides, and fixed coils in the branches of the circuit which embrace the extremities of the armature during the coinciding interval.

Current Regulator, J. F. McElroy, Albany, N. Y., 486,644. Filed March 21, 1892.

The terminals of the field coils are secured to fixed contacts and connected in circuit by a movable segmental contact plate, so that by adjusting this plate on its pivot, by means of two pawl and ratchet devices automatically actuated, the number of active field coils may be varied.

Electric Device for Vibrating Tables, W. L. Imlay, Camden, N. J., 486,715. Filed April 9, 1892.

Electric Clock, M. V. B. Ethridge, Everett, Mass, 486,838. Filed Jan. 18, 1892.

Electric Heater Casing, M. W. Dewey, Syracuse, N. Y. Design, 22,017. Filed Oct. 19, 1892.

Railways and Appliances :—

Insulating Chair for Rails, F. E. Kinsman, Plainfield, N. J., 486,477. Filed Feb. 23, 1892.

Claim 4 follows:

The combination with a railway rail and its support of an interposed sheet or plate of insulating material and a plate of iron or other metal clamped down upon the insulation so as not to move with the rail.

Trolley Wire Hanger, D. E. Lain, Yonkers, N. Y., 486,588. Filed April 11, 1891.

Employs grooved jaws partly embracing the wire, and means for clamping these jaws by moving them endwise on the wire.

Telephones and Apparatus :—

Electric Switchboard, C. E. Scribner, Chicago, Ill., 486,506. Filed Feb. 7, 1890.

Invention relates to the construction of a telephone switchboard and the loop plugs used in connection therewith.

Test System for Multiple Switchboards, C. E. Scribner, Chicago, Ill., 486,507. Filed Feb. 11, 1892.

Has for its object to provide means whereby it may be certainly determined at any board whether a line is in use at some other board; said means being distinct and separate from the line circuits.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED NOVEMBER 29, 1892.

Alarms and Signals :—

Burglar Alarm Cabinet, A. Stromberg, Chicago, Ill., 486,908. Filed July 9, 1892.

Auxiliary Fire Alarm Signal Apparatus, C. E. Scribner, Chicago. Filed June 1, 1888.

Provides an auxiliary circuit including generator and bell at one or more stations so arranged that when the generator is operated its bell will be rung until the brake wheel of the signal box begins to turn, whereupon the ringing will cease.

Burglar Alarm, H. W. Reynolds, Long Branch, N. J., 487,128. Filed April 6, 1892.

Distribution :—

Development and Distribution of Electricity, J. S. Stone, Boston, 487,102. Filed Oct. 10, 1891.

Employs a conductive circuit and inductive circuit, and a single bridge connection forming a conductive section common to both of said circuits, a generator in the conductive circuit, a transmitting device in the inductive circuit, and a current varying device in the bridge connection.

Lamps and Appurtenances :—

Electric Arc Lamp, C. E. Scribner, Chicago, Ill., 486,938. Filed Jan. 2, 1888.

Invention consists of a lifting magnet in the main circuit, a fine wire magnet, in shunt around the arc, and a shunt around both these magnets including resistance and contact points controlled by either of said magnets to open or close the shunt circuit including the resistance.

Adjustable Electric Light Holder, L. S. Pfouts, Canton, O., 487,022. Filed Feb. 24, 1892.

Electric Light Carbon, J. Clegg, London, England, 487,046. Filed April 10, 1890.

Invention consists in treating the filaments with certain metallic compounds with the object of making them more durable and efficient.

Incandescent Lamp, J. H. F. Görges, Berlin, Germany, 487,049. Filed April 20, 1892.

Claim 1 follows:

An incandescent lamp provided with three terminals connected with each other through three independent carbon filaments of equal resistance.

Automatic Electric Lighting Apparatus, L. G. Woolley, Grand Rapids, Mich., 487,109. Filed June 6, 1892.

An automatic electric lighting apparatus so arranged that by the operation of a single lever the inlet valve to a motor is open and a dynamo thrown into operation by the tightening of its operating belt.

Incandescent Lamp Socket, C. B. Elliott, Boston, 487,213. Filed August 8, 1892.

Consists of a rigid base having the lamp contacts molded permanently therein in a given plane and coupling contacts rigidly held in a plane at right angles thereto.

Electrode for Arc Lamps, C. W. Hazeltine, St. Louis, Mo., 487,220, Filed May 6, 1892.

Has for its object to effect a saving of carbon by coating the electrode with a covering of copper and another of zinc.

(See page 544.)

Measurement :—

Electric Current Indicator, C. P. L. Noxon, Syracuse, N. Y., 487,093. Filed Nov. 24, 1891.

Has for its object to provide apparatus for determining the strength of any kind of current by employing the direct application of the current to be measured in actuating the indicating of the apparatus.

Metal Working :—

Magnetic Separator, T. J. Lovett, Chicago, Ill., 487,073. Filed Feb. 13, 1892.

Magnetic Separator, T. J. Lovett, Chicago, Ill., 487,074. Filed Feb. 13, 1892.

Miscellaneous:

Machine for Covering Wires, J. A. Barrett, Brooklyn, N. Y., 486,845. Filed May 10, 1892.

Magnetic Separator, T. J. Lovett, Chicago, Ill., 486,879. Filed Feb. 13, 1892.

Galvanic Body Battery, J. W. Shults, Wichita, Kans., 486,902. Filed March 22, 1892.

Electrical Transformer, E. Thomson, Swampscott, Mass., 486,916. Filed May 23, 1892.

Claim 1 follows:

A transformer for electric circuits provided with means for varying the length of one of its windings in a continuous unbroken manner.

Coil for Electrical Apparatus, H. C. Buck, Somerville, Mass., 486,926. Filed Dec. 5, 1884.

Invention consists in a coil composed of a series of convolutions being surrounded by a coating of paraffine or other plastic insulator.

Electro Magnetic Pulley, W. E. Harrington, Atlantic City, N. J., 487,070. Filed June 2, 1891.

A pulley having a rim of conducting material made magnetic by suitable windings, a hub of conducting material, a wheel centre of non-conducting material, and a connection from the hub to the windings of the rim.

Electric Belt, J. H. Johnson, Dodgevillen, Wis., 457,185. Filed July 21, 1892.

Process of Electro-Depositing Alloys, S. Q. Cowper-Coles, London, 487,176. Filed Nov. 18, 1891.

Railways and Appliances:—

Trolley for Conduit Railways, B. Olbricht, Brooklyn, N. Y., 486,985. Filed May 17, 1892.

Invention consists of a conduit having metallic conductors attached to the under side of the top one on each side of the slot, and a hinged spring actuating trolley arm with two contacts each provided with a swinging casing to prevent short circuiting in the case of water rising to the level of the trolley.

Device for Transmitting Motion for Electric Street Car Motors, W. E. Harrington, Atlantic City, N. J., 487,069. Filed Oct. 4, 1890.

Claim 1 follows: The combination with two pulleys made powerfully magnetic by suitable winding of an endless belt of magnetic material running over said pulleys and held thereto by magnetic traction.

Electric Locomotive, C. M. Conradson, Madison, Wis., 487,124. Filed Dec. 2, 1891.

Employs a system of gearing that may be used when required for extra power and thrown off connection when the circumstances do not require their use.

Switches and Cut-Outs:—

Electric Switch, W. J. Schultz, Detroit, Mich., 486,987. Filed June 27, 1892.

Relates to means whereby the switch lever may be thrown in opposite directions by the action of the same spring.

Safety Device for Electric Circuits, G. Cutter, Chicago, Ill., 487,002. Filed Feb. 19, 1892.

Has for its object to provide convenient means whereby fuses of the right size may be substituted for those that are blown out.

Electric Switch, J. J. Nate, Chicago, Ill., 487,092. Filed Mar. 29, 1892.

Relates to switches and rheostats for use in connection with elevators, and provides means for closing the circuit through the field of the motor before that of the armature.

Telegraphs:—

Electrical Transmitting Appartus, A. D. Neal, Boston, and H. F. Eaton, Cambridge, Mass., 486,888. Filed April 17, 1891.

Has for its object to provide an apparatus whereby letters or other characters may be transmitted over a single line wire as rapidly as the keys can be manipulated

Typewriting and Printing Instrument, A. D. Neal, Boston, and H. F. Eaton, Quincy, Mass., 486,889. Filed June 9, 1891.

An electric printing telegraph on the principle of the typewriting machine.

Telegraphic Apparatus, J. A. Parker, St. Louis, and L. L. Summers, Chicago, Ill., 487,154. Filed Jan. 27, 1891.

Invention has particular reference to the use of machines both as transmitters and receivers, having devices approximating the Bartholomew stenograph shorthand machine.

Electrical Typewriter, A. D. Neal, Boston, and H. F. Eaton, Quincy, Mass., 487,227. Filed May 27, 1892.

A type telegraph system employing typewriting machines of any ordinary construction as receivers and transmitters.

Telephones and Apparatus:—

Automatic Telephone or other Electrical Exchange, A. B. Strowger, Chicago, Ill., 486,909. Filed Feb. 19, 1892.

Invention relates to means for switching any electrical instrument into electrical connection with any other electrical instrument of a given system, and provides means whereby a person at one station may make connection with any other station without the assistance of an operator at a central station.

Multiple Switchboard System, C. E. Scribner, Chicago, Ill., 487,096. Filed Mar. 5, 1892.

Employs a connecting plug consisting of a central conducting core and a concentric conducting sleeve insulated from the core and allowing a part of the core to extend beyond its end, and insulating pit secured to said core.

Telephone Exchange System, C. E. Scribner, Chicago, Ill., 487,097. Filed Apr. 16, 1892.

Provides means whereby sub-stations may be divided into several groups each with a separate switchboard and each member of each group being enabled to obtain connection at one or the other of the switchboards with another member of the same or of another group respectively.

Telephone Switchboard Apparatus, C. E. Scribner, Chicago, Ill., 487,098. Filed Apr. 21, 1892,

Provides means for automatically disconnecting the operator's telephone set from a telephone line circuit.

Telephone, C. V Hayes, Cambridge, and W. L. Richards, Malden, Mass., 487,219. Filed Sept. 10, 1892.

A magneto telephone for two circuits comprising a double pole magnet and helices for each circuit, the poles and helices of each magnet being arranged in a position inductively neutral to those of the other.

Electric Typewriter, A. D. Neal, Boston, and H. F. Eaton, Quincy, Mass., 487,228. Filed May 27, 1892.

A type telegraph employing an automatic field mechanism for the ink ribbons of the transmitting and receiving typewriters.

Printing Telegraph, A. D. Neal, Boston, and H. F. Eaton, Quincy, Mass., 487,229. Filed Apr. 21, 1891.

Employs a typewriter which may be used for ordinary office work use as well as a transmitting instrument, each character being under the control of a magnet actuated by means of the key lever.

MR. S. G. NEILER has severed his connection with the Thomson-Houston Electric Company, of Boston, where he had charge of central station construction in New England for the past two years, and is now connected with the World's Columbian Exposition in Chicago, as second assistant electrical engineer under Mr. Frederick Sargent.

OBITUARY.

JAY GOULD.

THE death of Mr. Jay Gould, last week, at the early age of 57, has been the theme of numberless newspaper articles; and the endless columns of biography, gossip, criticism and conjecture as to the size of his fortune leave little to be said that can be of any value to the electrical engineer. Mr. Gould's connection with electricity was wholly through his telegraph and cable interests; in fact, it has been generally understood that of the later developments of electricity he had little knowledge. It has even been said, more than once, that he did not like the electric light and did not entertain a very high opinion of electric traction. This simply shows that Mr. Gould was not a pioneer, that he had not found time of late years to look far beyond the limits of his existing "investments," and that probably he would not have become interested in telegraphs had it not been for his strong personal friendship for General T. T. Eckert. The story of the Atlantic & Pacific and American Telegraph oppositions is old and hackneyed, but the fact that Mr. Gould died the possessor of between $20,000,000 and $30,000,000 of Western Union stock is proof that Genl. Eckert enabled his staunch ally to reap by them the fruit of an unparalleled opportunity. Mr. Gould was a director of the Western Union Co. for twelve years, and his term of control witnessed the acquisition of the Mutual Union and Baltimore & Ohio properties. Mr. Gould is reported to have left about $75,000,000, largely in railroads, as might have been expected. He was essentially a railroad speculator and his first relation to telegraphy was for him a fortunate accident.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

The judicious placing of advertisements is an important part of any progressive business.

THE SPERRY RAILWAY MOTOR AT PITTSBURGH.

A GREAT deal of interest has been taken in the Sperry motor since its exhibition at the Cleveland Street Railway Convention, and it has now been installed on various roads. The following is an expert report of a test of its capabilities on the road of the Suburban Rapid Transit Company at Pittsburgh, Pa.:

"We made the 1¼ miles up the grade in eight minutes one trip, and ten minutes the next, with three stops. It runs very smoothly. This is the new line just opened by the Suburban Rapid Transit Company and is the one which connects with the Birmingham Traction Company's lines at Carson street, going up the hill and connecting with the original suburban line out in the country. The detail of the particular grade spoken of is as follows: Ten per cent. grade for 300 feet, then a railroad crossing; 6.3 grade for 5,850 feet beyond that point; the remaining 300 feet varying from 1 to 3 per cent. grade; there being in this 6.3 grade eight curves of rather small radius. The more I use the motor, the better I like it; it is a dandy."

THE COLEMAN STORAGE BATTERY.

A LARGE share of the attention of electrical workers has recently been turned towards improving the storage battery. Mr. Clyde Coleman, of the Electric Specialty Co., 85 Fifth avenue, Chicago, has been an earnest worker for some time past in this direction, and as the result of his labors has invented a new form of storage battery which is formed directly by a special electrolysis process, no applied oxides of any kind being employed. With this cell he is able to obtain six ampere hours capacity per pound of cell without shortening the life of the battery or deteriorating it in any way. The new cell, it is said, differs from all other cells of this class, as the active portion of the plates is formed of a peculiar fibrous texture capable of withstanding the highest discharge or even absolute short-circuits without any injury, buckling or other troubles incident to severe working of a battery. Another feature is that if the plates are taken from the cell and left to dry, the active material does not become brittle or crumble. These cells seem likely to become very popular. Attention is called to the announcement made in our advertising columns regarding them.

A MUNICIPAL PLANT FOR LANSING, MICH.

MR. J. P. THOMAN, superintendent of the Board of Water-Works and Electric Light Commissioners, of Lansing, Mich., writes us: "As an item of news I would say that our city has this day, December 1, taken possession of the electric lighting plant of our city company. It will hereafter be run in connection with the water-works and under the same board and superintendent."

THE WIRT ELECTRIC INDICATORS.

These instruments are designed to meet the severe condition of the most exacting commercial practice in electric lighting. The intention of the designer has been to produce an electrical measuring instrument without the faults of temporary or permanent variation, mechanical defects or imperfect design so often found in instruments of this class and which, to quote Mr. Swinburne, "Measure nothing in particular." Whether the object has been fully or even partly accomplished the following description will perhaps enable the reader to judge.

Fig. 1 is a view of the inside of a volt indicator, and Fig. 2 that of an ampere indicator. The cases are similar to high grade steam gauge cases and have cast iron boxes with heavy ornamental polished bronze rims. These rims are cast and have the "draw-file" finish so much admired, instead of being spun and buffed according to the usual practice with work of this class. The glass front is finished in black and pure gold leaf. The case is moisture proof, dust proof and "time proof," which is a very important matter and often not appreciated. Fig. 3 is a detached view of the armature system.

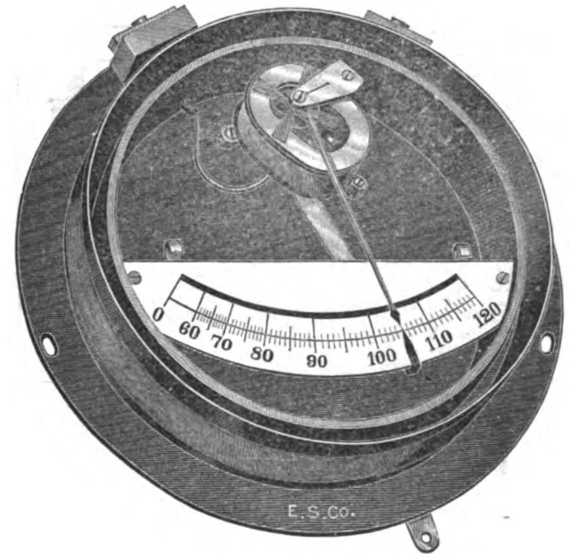


Fig. 1.—Wirt Volt Indicator.

The resistance wire used in the volt indicators is one of the new alloys which have appeared in the past few years. The one selected has not the highest resistance nor the least temperature variation of those tested for the purpose. It is superior to 18 per cent. German silver in both qualities and remarkably constant as regards slight change from year to year, which is the most important feature by far in this case.

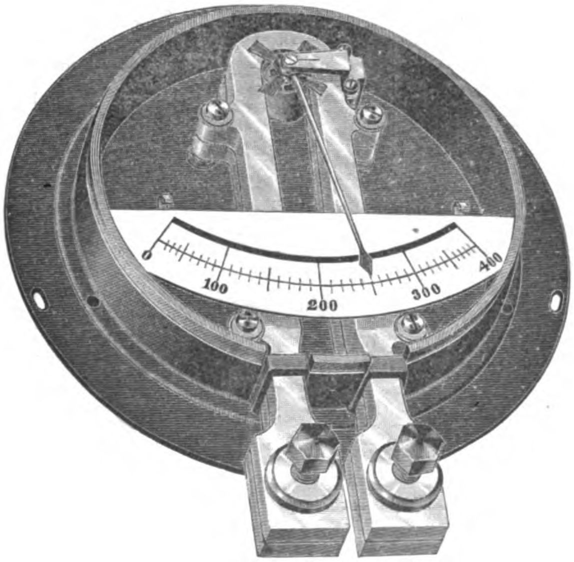


Fig. 2.—Wirt Ampere Indicator.

It is manifestly impossible to simplify an action consisting merely of a stationary coil acting on a light piece of iron free to move in response to the attraction exerted.

In such an instrument the moving parts are reduced to one, control is left to gravity; the varying strength of the field due to the coil is known to be rigidly proportional to the current in the same, and it is only required that the iron which acts as the straw in the magnetic "wind" shall be so selected, shaped, treated and acted upon, as to eliminate "magnetic memory."

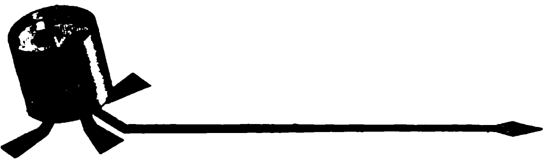


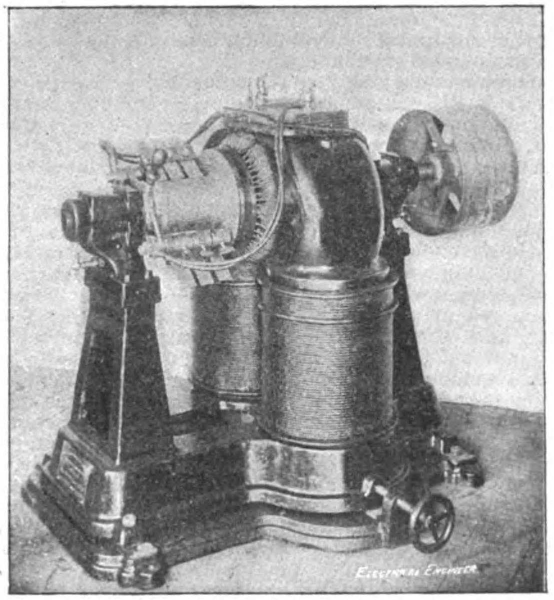
Fig. 3.—Armature System of Wirt Indicators.

Fig. 1 shows the interior of the 120-volt indicator. The action consists of an oblong spool having ends with a cylindrical curve. The armature is a semi-cylinder of thin sheet iron suitably attached to a light steel spindle with conical ends carried in jeweled cups of special shape designed to give the maximum sensitiveness. The attached pointer is made of thin bronze ribbon having the stiffness of tempered steel and formed to a V section. Aluminum was tried for these pointers at first, but it was found that weight for weight, other materials were stiffer and more satisfactory.

Fig. 2 shows the interior of a 400 ampere indicator, the conductor consisting of a single turn. For large size ampere indicators, the "coil" or strap is cast of pure copper. These instruments are being put upon the market by the Electrical Supply Co. of Chicago.

LIGHTING THE WINTER CIRCUS, PHILADELPHIA.

A new amusement place has been built and opened in Philadelphia. It is certainly a most novel entertainment, and the only one of its kind in America. It is called the "Winter Circus" and is a combination permanent circus, ballet and variety performance. One of the most prominent and handsome features in the entire installation is the electric lighting system which has been installed by the La Roche Electric Works, of Philadelphia. The lighting is done in four colors. white, green, red and blue.



La Roche Dynamo for Winter Circus, Philadelphia.

In the dome of the building there is an electrolier 47 feet in diameter whereon are 300 colored lights neatly arranged. There are two galleries and on them are also placed colored lights. The entire wing is so grouped on an automatic switchboard that the entire house can be changed instantly to the various colors. In the dome is arranged a water-fall. The water falling on the circular stage, under the effect of the different colored lights, is very beautiful. The effect of the colored lights on the ballet is also very fine.

There is placed in the dynamo room a Southwark engine, one 400-light La Roche incandescent, compound wound dynamo, and two 20-light arc dynamos. There are altogether 750 incandescent lights and 53 arc lights. The La Roche Electric Works should be complimented upon the beautiful effect of the entire installation, and on their new automatic dynamo here shown, as there is only a variation of 1¼ volts from no load to full load. The machine is well built and runs with the utmost smoothness.

THE MODERN BOILER PLANT OF CURTIS DAVIS & COMPANY, CAMBRIDGEPORT, MASS.

Electrical engineers will be interested in the description of a strictly modern boiler plant, which has been designed and constructed for Curtis Davis & Company, manufacturers of soap and glycerine, Cambridgeport, Mass., by Westinghouse, Church, Kerr & Company, of Boston; the detail work being carried out by William R. Roney, the engineer of their stoker department. Carte blanche was given the engineers to design a boiler house to contain every practical element of economy which could bear upon the sum total of the cost of making steam; they being limited only to the horizontal return-tubular type of boiler by certain considerations outside of economy.

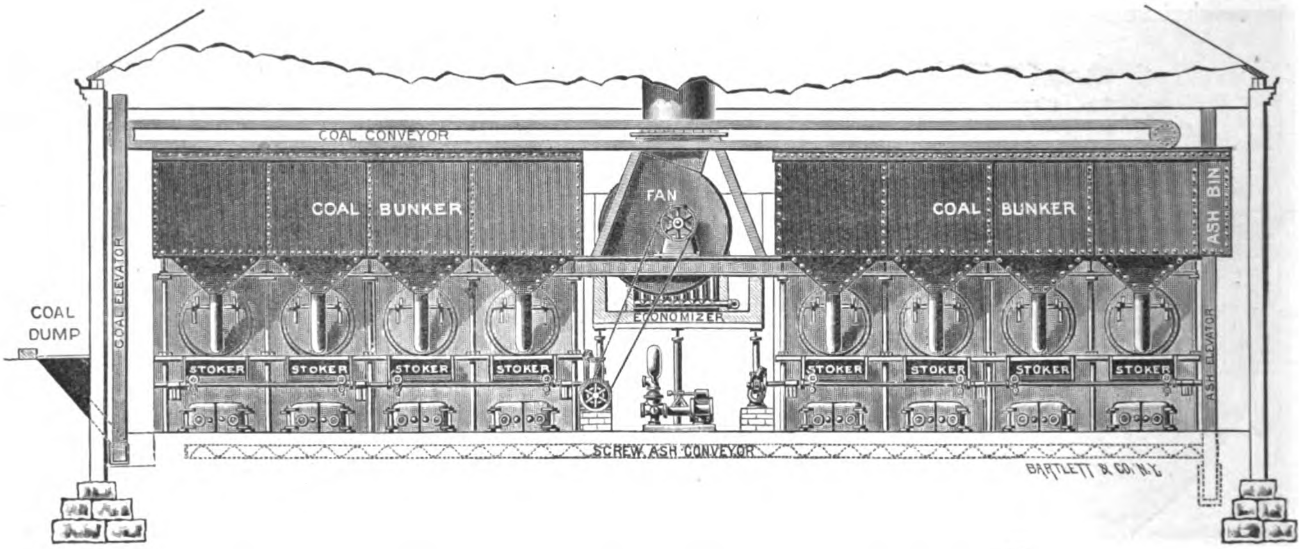


Fig. 1.—Boiler Plant of Curtis Davis & Company, Cambridgeport, Mass.

The architectural design of the boiler house was prepared by Hartwell & Richardson, of Boston. The building is of pressed brick with trimmings of pink Milford granite. The roof is of iron trusses, covered with slate and lined on the inside with wire lath and plaster, for the purpose of preventing condensation. The fire room floor is of concrete. An annex to the building contains a scale room for tallying the weight of coal, and a complete wash room for the fireman, who has now become a gentleman of leisure.

The operative portion of the plant will, when completed, consist of eight horizontal return-tubular boilers of 125 nominal h. p. each, to carry a working pressure of 130 pounds. These boilers are arranged in two batteries of four each in either end of the building (one battery is now in operation), the space between being utilized as a pump room. Following the progress of the coal, after it is weighed, it is dumped onto a grating at the end of the boiler house, shown in the view Fig. 1. The large lumps are easily broken by the teamster, the grating serving as a screen to reduce the coal to a uniform maximum size. From the grating the coal falls into a bucket elevator carrying it to an overhead conveyer extending the entire length of the boiler house, shown in Fig. 1, from which it distributes into square iron bunkers having hopper bottoms. From the bunkers the coal flows by gravity through swivel spouts to the hoppers of the stokers as shown in Fig. 2.

Each boiler is equipped with a Roney mechanical stoker. The power to operate the entire battery of stokers is a small engine carried on a bracket at one end of each battery, and driving a slow-moving eccentric shaft.

A most interesting portion of the plant is the means of securing controllable draft. The usual expensive chimney stack is conspicuous by its absence, and in its place will be found a steel stack 72 inches in diameter, extending 17 feet above the ridge of the roof and showing a total height to the top of about 55 feet above the ground. This stack is lined with one course of brick merely to prevent rust, and is finished with ornamental top similar to the familiar shape on the smoke stacks of the Pennsylvania Railroad locomotives. The stack having no functions, so far as the production of draft is concerned, is only of a length sufficient to deliver the gases above the roof. The stack is supported on an entablature, which in turn is carried on "I" beams over the boiler room. On these "I" beams is a large slow-running exhaust fan whose outlet discharges directly up into the bottom of the stack, as shown in Fig. 1. The waste gases from the furnace pass through a Lowcock economizer, which opens into the suction of the fan. The economizer is carried on iron columns, and the whole system is therefore overhead and out of the way, leaving a clear floor space below. A by-pass damper is provided on each side of the economizer, so that the draft can be direct to the stack in case the economizer is temporarily out of service for repairs. A steam-cone nozzle may be set in the base of the stack as a relay in the remote contingency of any necessity for overhauling the fan. The probability of repairs is best judged by the fact that the usual speed of the fan in ordinary service is from forty to fifty turns per minute, and when driven at the slow speed of eighty turns per minute it is sufficient to cause a draft adequate to the most intense combustion. The motive power of the fan is a small Westinghouse engine, nominally of 10 h. p., but in fact running at so slow a speed and under such a close throttle as to develop only a fraction of that power. The draft is automatically controlled by a pressure regulator in the steam pipe to the engine, so that the speed of the fan is varied according to the steam pressure in the boilers, being in this respect the equivalent of the most sensitive steam damper. This scheme of mechanical draft is capable of producing a draft pressure equal to that of a 200 foot chimney costing ten times as much to build, and additionally possesses the feature which no natural draft enjoys, of absolute flexibility in meeting sudden demands of steam.

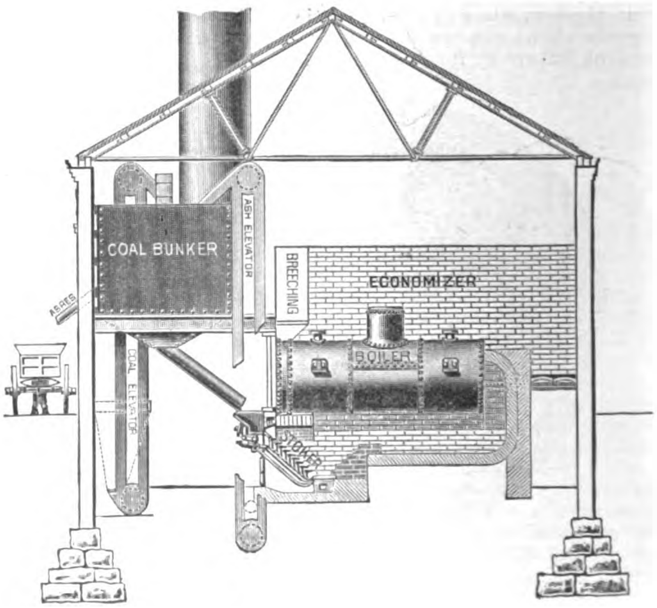
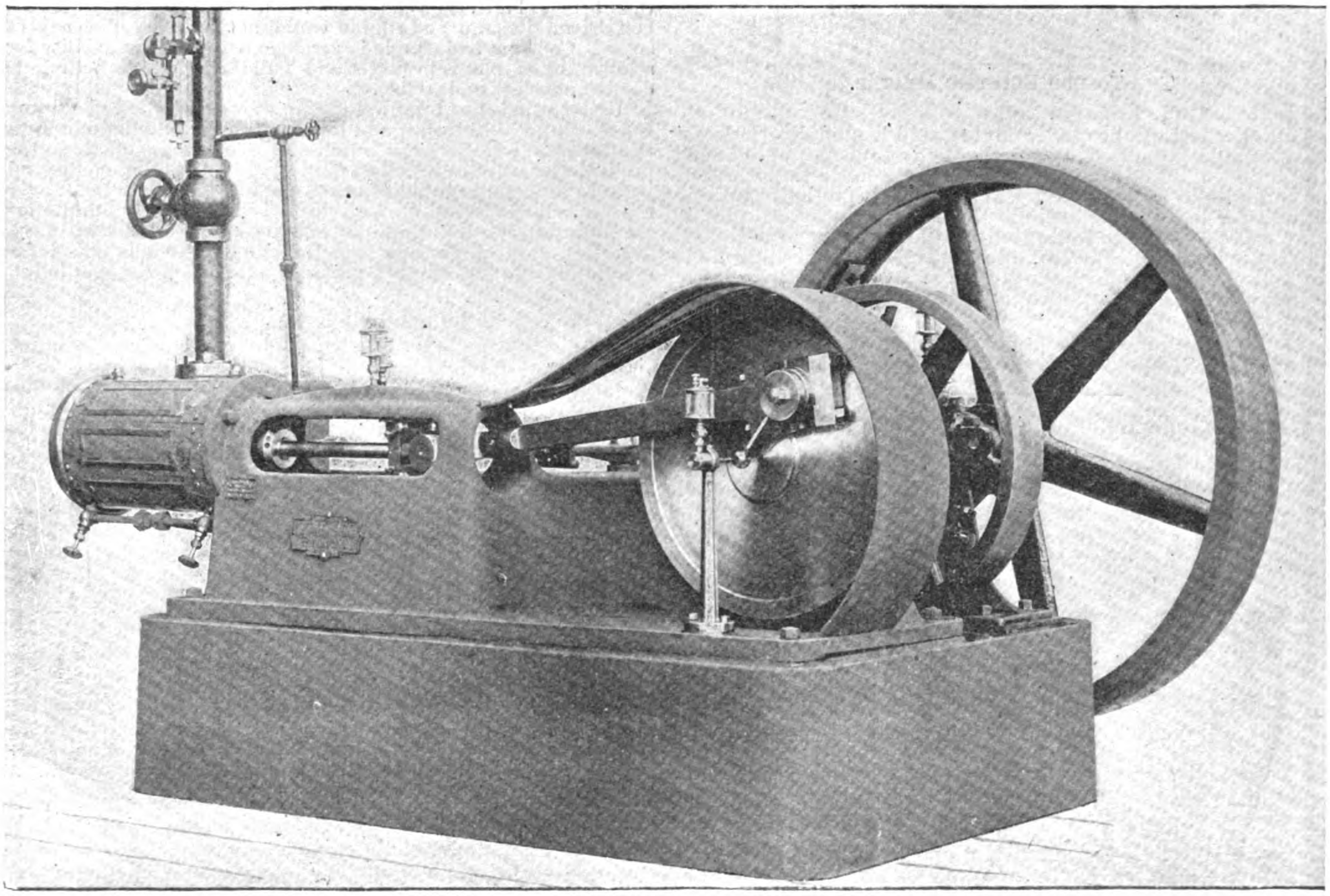


Fig. 2.—Cross Section of Boiler Plant.

The action of the economizer is, to extract all the available heat from the waste gases and return them into the boiler. The temperature of the uptake is about 100°, the temperature of the feed-water leaving the economizer being upward of 300°, and representing an amount of heat saved which would otherwise be wasted up the stack as the only means of producing a natural draft. The pump-room is located, as before mentioned, between the batteries of boilers underneath the economizer, and in it are two duplex pumps of a capacity of 500 gallons per minute each. These pumps are controlled by pressure regulators, and are so connected that while one of them is furnishing the ordinary elevator service the second one is kept slowly moving, so as to be in condition for instantaneous fire service. The work of these pumps is alternated daily, and in case of fire both can be concentrated immediately on the fire lines. In the same pump-room are double boiler feed-pumps, each one adequate to the entire capacity of the plant. All the hot-water lines and fittings are of brass, and by-passes are provided so that the feed-water can be pumped through the economizer, or direct to the boilers in case of repairs to the latter. A further system of a water meter with by-pass valves is so arranged that the feed-water can be measured and pumped to either boiler independently, or to any number of boilers, or to the entire battery, at will. With a water meter in the feed line and a pair of scales at the gate, it is proposed that the condition of the entire plant, as to its evaporative duty, shall be daily logged and reported to the office, and any decline of efficiency be thereby promptly and practically detected.

NOYE ELECTRIC LIGHT ENGINES FOR STEAMBOATS.

When contracting for electric light plants for the fine new steamers of the Menominee Transit Company, Cleveland, Chief Engineer Calder required, as a preliminary condition, that special engine designs be submitted. It is frequently necessary, in boat work, to provide the engine with an iron sub-base of strength and weight—one that will make the engine absolutely self-contained. Moreover the governor must be especially easy of access, both for taking up and for lubrication, and be of such design and construction as to regulate within the least possible percentage while remaining insensible to the motion of the boat.



Noye Electric Light Engine for Steamboat Work.

To meet these conditions the John T. Noye Manufacturing Company, of Buffalo, N. Y., submitted designs of the engine, which we illustrate herewith, and these Mr. Calder accepted. Six engines were accordingly furnished, and as proof of their having completely "filled the bill" it can be said that they have needed no repairs or extra attention during the season, and are now, at its close, in perfect condition, although much of the time they have run with a steam pressure of 150 pounds instead of the 100 allowed for by the builders.

These engines are of six-inch bore, 10-inch stroke, and run at 300 revolutions. The top of the fly-wheel turns toward the cylinder, but can be made to run the other way if desired. The governor is an adaptation of that used on the Noye heavy-duty B style engine, and ensures perfect regulation. Every engine is carefully tested and adjusted, and can be shipped complete without affecting the adjustments. Other particulars may be obtained of the John T. Noye Manufacturing Co., Buffalo, N. Y.

THE J. G. BRILL COMPANY.

The J. G. Brill Company are just constructing an electric railway around their entire works for the purpose of testing electric cars turned out at their works. The road will possess sharp curves and as heavy grades as are found on ordinary street car lines. Current will be supplied from their own plant at the works.

The company are building a large number of cars and trucks for the following companies: Lynn & Boston Railway Company, Lynn, Mass.; Wilkesbarre & Wyoming Traction Company, Wilkesbarre, Pa.; New Britain Tramway Company, New Britain, Conn.; Washington, Alexander & Mt. Vernon Railway, Washinton, D. C.; Scranton Traction Company, Scranton, Pa.; Hornellsville & Canastota Railway, Hornellsville, N. Y.; Lakeside Railway Company, Montgomery, Ala.; Columbia Street Railway Company, Columbia, Pa.; and Central Construction Company, Wheeling, W. Va.

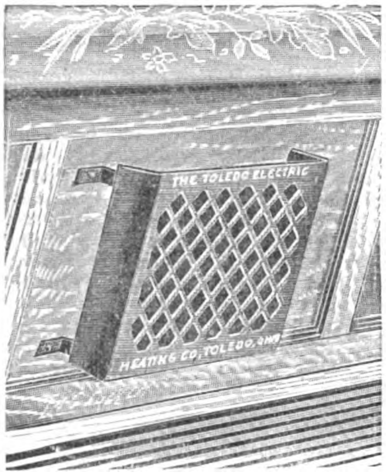
CHEAPER BEACON LAMPS.

The Beacon Vacuum Pump and Electrical Company, of Irvington street, Boston, and 141 Liberty street, New York, make this week an important announcement with regard to the reduction of prices of incandescent lamps made by them. They now offer their 16 c. p. lamps at 35 cents, on all orders beginning with as small a quantity as 200 lamps, which may even be in assorted sizes; terms net, 30 days. They also offer, on similar conditions, their 16 c. p. anchored filament railway lamps at 40 cents. This is an excellent offer, especially for those who have not yet tried the Beacon lamps, for whose life, brilliancy and minimum of blackening some very remarkable claims have lately been made and sustained.

THE TOLEDO ELECTRIC HEATER.

THE TOLEDO ELECTRIC HEATING COMPANY, of Toledo, O., are manufacturing a heater for electric street cars for which many strong claims are made.

These heaters are 13 inches long, 10 inches high and 8 inches thick, made to screw on the riser under the front edge of the seat next to the floor of the car. Four are used in an ordinary street car, running in a series of two so that two of them can be cut off when desired. They can also be made to run in a series of three for cars over twenty-one feet long. One and one-half amperes are used for two heaters, making three amperes for four heaters in an ordinary car and four and one-half amperes per car where six heaters are used. The switches and fuse box can be placed in any part of car. The price per car of four heaters is $20, making $5 apiece for each heater. Switches and fuse box to go with each set of heaters.

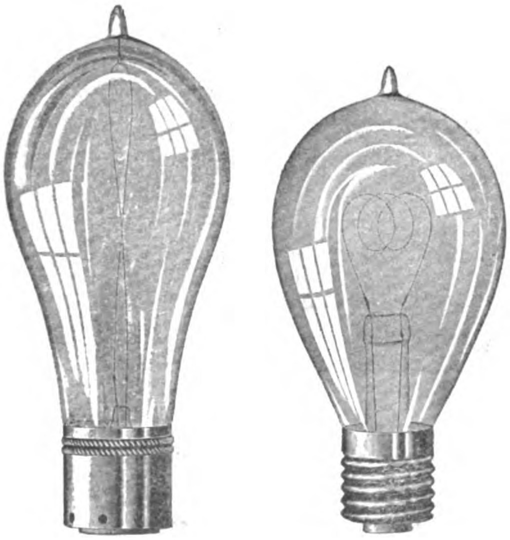


THE TOLEDO ELECTRIC HEATER.

The accompanying illustration shows one of these heaters placed on the "riser" beneath the seat of a car.

NEW LAMPS OF THE GENERAL ELECTRIC CO.

THE demand for a thoroughly high class incandescent lamp, especially adapted to the lighting of street cars, or for use on power circuits, has been steadily growing during recent months. At the lamp works of the General Electric Company a series of experiments in the direction of satisfying this demand have lately been made with entire success. The outcome of the experiments is three special types of lamp to satisfy the exacting requirements of railway and power work.



FIGS. 1 AMD 2.—GENERAL ELECTRIC CO.'S RAILWAY LAMPS.

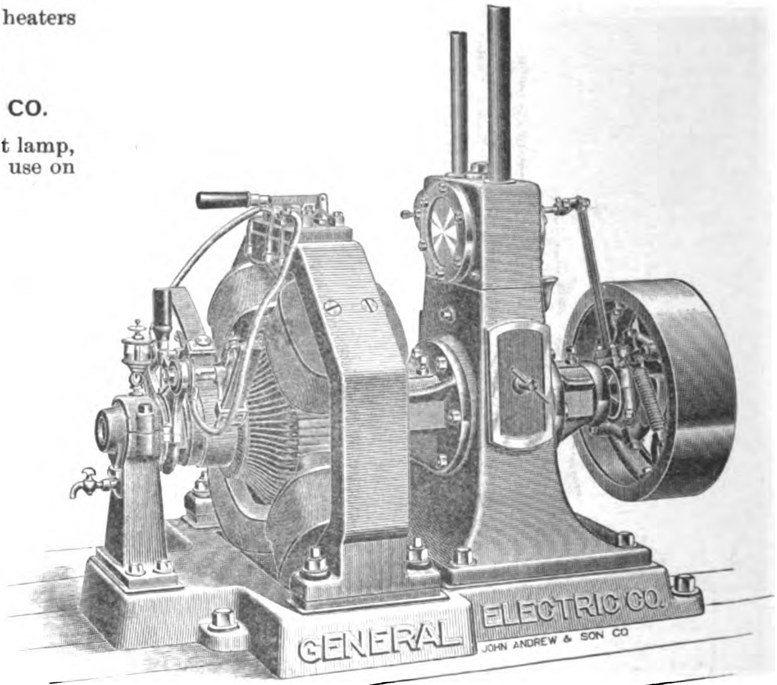
The first lamp is the straight unanchored filament lamp, differing in no way in appearance from the ordinary incandescent lamp. This lamp is rated according to the amount of current consumed, and only those consuming the same amount of current should be used in any one series. In the anchored filament lamp, Fig. 1, the chance of breakage of the filament by sudden contact with the glass of the bulb caused by motion of the car, is, it is claimed, entirely obviated. The design of the spiral filament lamp, Fig. 2, is the most novel and most pleasing. As will be seen the filament is made in three spirals, mounted on a heavy glass centre, and requires no extra support.

Great care is exercised in the manufacture of the two last named lamps in order to render the resistance exactly the same throughout each form, so that any "spiral" or "anchored" filament lamp may be used with others of similar form. Neither one, however, is intended to be used in series with the others.

A NEW DIRECT COUPLED GENERAL ELECTRIC ENGINE AND DYNAMO.

THE direct coupled generator and engine in one compact set, is, under conditions of restricted space and position, the ideal electrical plant. The illustration shows a small, direct coupled generating set, recently perfected and manufactured by the General Electric Company, and representing the result of two years of careful practical experience. For marine installations, where a separate engine is indispensable to drive the generator, these sets are especially adapted. As cheap as, if not even less expensive than belted plants, they can be readily fitted to positions where a belt driven dynamo and engine could not find a sufficiency of space. Compact and simple in arrangement, their suitability for small isolated plants in hotels and buildings, where belting is objectionable, is undeniable.

Under exhaustive tests, the engine shows a very high economy for machines of this size, and its simplicity is such as to reduce the attention necessary to a minimum. The generator is of the familiar General Electric Company quadripolar type, compound wound, having a regulation automatic within two per cent. over the entire range from no load to full load. The commutators are cross-connected, so that only two brushes, 90° apart, are used. The rheostat is of the new iron frame incombustible type. The engine and dynamo are both provided with self-oiling bearings.



DIRECT COUPLED GENERAL ELECTRIC ENGINE AND DYNAMO.

The sets are manufactured in 4, 8, 15, 30 and 50 kilowatt capacities.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.
VOL. XIV. DECEMBER 14, 1892. No. 241.

THE LIFE WORK OF WERNER VON SIEMENS.

THE ocean cable, which he did so much to make practicable and perfect, brought to this country last week the news that Werner von Siemens had died in Germany at the ripe age of 76, after a life full of work and honors, embracing in its range of activity every practical advance made in electrical engineering during the last fifty years from the telegraph down to the electric railway. Few men have done as much as he for the practical applications of electricity, and his achievements will live long after him. The electrical industries which he helped to establish, with his wonderfully talented brothers, William and Charles, are among the largest and foremost of their kind in Germany, Austria, England, and Russia; while the current year has seen the United States included directly within the sphere of Siemens influence and energy, by the transference of part of the spare capital and technical force of Siemens & Halske to Chicago, where a large factory has been equipped and started for the production of their dynamos, motors, etc.

Werner Siemens's work was spread over a large variety of subjects, but his chief fame rests upon his contributions to electrical science and to electrotechnics. Even among these we must limit ourselves to the most important only—they are so numerous. It was in 1842, that is, two years before Morse operated his first line between Washington and Baltimore, that Siemens, then a second lieutenant in the Prussian army, and only 26 years old, took out his first patent for a "Process of Making Gold Plating Solutions," and shortly after he developed with his brother, Chas. W. Siemens, and Prof. Himly, of Göttingen, a method of plating which was taken up by the Elkingtons, of Birmingham, and worked successfully. At that time, it must be remembered, electro-plating was largely occupying the attention of electric workers, and it was in this field that Siemens naturally sought for the most immediate returns for his labor. He was young and poor.

The advent of the telegraph, however, and the success which it immediately scored must have impressed Siemens with the great future in store for this department of electrotechnics. It was little wonder, therefore, that he turned to this subject with energy and enthusiasm. As early as 1847 we find the young Hanoverian applying for a patent on a method for preventing the sluggish action of the receiving magnets of telegraph instruments, and for another patent on an improved printing device. It would take us too long to enter into the details of these mechanisms and of many others which followed. Among these were a repeater invented in 1854, and many improvements in the manufacture of submarine cables, Siemens being among the first to recognize the value of gutta percha for submarine work.

Early in his career Siemens had associated himself with a clever mechanic, Mr. Halske, and thus were laid the foundations for the great firm of Siemens & Halske. As early as 1848 that firm undertook a large contract for a telegraph line and its apparatus between Frankfort and Cologne, and at the great International Exhibition in London in 1851, they showed a varied assortment of telegraph instruments and appliances.

But it is probably in connection with the dynamo electric machine that Werner Siemens's name is most widely known, his discoveries in regard to it constituting his chief claim to be placed among electrical worthies. As early as 1856 he had arrived at the form of armature familiarly known as the Siemens double-T armature, which he used in connection with a needle telegraph apparatus, the armature being rotated in the usual field formed by permanent magnets. It was nearly nine years afterwards, on the 17th of January, 1867, that Prof. Magnus communicated to the Royal Academy of Sciences, at Berlin, a paper entitled, "On the Transformation of Magnetic Energy into Electric Current Without the Use of Permanent Magnets." This communication describes the great discovery made by Werner Siemens, namely, that the current generated by the armature could be utilized for the energizing of the field magnets, and that separate independent magneto exciters, such as had been employed theretofore, were no longer necessary.

Although first brought to the attention of the public in 1867, the earliest recorded mention of this discovery by Siemens appears to have been in a letter from him to his brother William Siemens in London, dated Dec. 24, 1866. In this letter he describes the building up action that takes place in dynamo machines, and there we find this prophetic paragraph. "The effect must, with proper construction, be enormous. The thing is very capable of development, and may form a new era in magneto-electricity. In a few days the apparatus will be ready, and magneto-electricity will by this means become cheap, and electric lighting, galvano-metallurgy, and even small electro-magnetic machines, receiving their power from large ones, may become possible and useful." It is not often given to men to see their predictions verified in the way that has fallen to the lot of Werner Siemens. Without detracting from Siemens's just fame in this discovery, it may be noted in passing that Prof. Moses G. Farmer ran him close with the independent discovery of the principle in this country.

With the advent of electric lighting, Siemens devoted considerable attention to this department, and to him is due the ingenious idea of the differential arc lamp, the constructive details of which were carried out by von Hefner-Alteneck. To Siemens is also due the successful carrying out of the first European electric railway at the Berlin Exposition in 1879, and to the European roads which immediately followed this successful experiment.

But besides his numerous arduous duties in the mechanical and financial world, for he was perhaps as able a banker as he was an engineer, Werner Siemens had also found time for study and speculation on the conditions of mankind as they present themselves in the light of the newer electrical development. But a few years ago, in discussing the condition of the earth's inhabitants when our available coal shall have been exhausted, Siemens pointed out that the electric current might afford means for fuel supply, in the electrolytic generation of oxygen and hydrogen, or again, in the decomposition of salts and the obtaining of sodium, potassium, etc., which could be used as combustibles, the natural forces, such as waterfalls, being employed to drive the electric generators.

As to the possibility of the manufacture of nitrogenous food products, Siemens has also pointed out that as ozone can be generated electrically, and as it has a marked affinity for nitrogen, it would seem to promise at least one method of obtaining a combination, which might, by the aid of chemistry, furnish us with digestible nitrogenous materials.

Dr. Siemens was a member of the Prussian Order of Merit, and the late Emperor Frederick conferred upon him a patent of nobility. The dignity of Doctor of Philosophy, *honoris causa*, was awarded him by the University of Berlin in 1860. He was the recipient of a great many honors at home and abroad, and was a member of several of the European learned societies. He was well known to American electricians, to one of whom, Mr. W. J. Hammer, we are indebted for the use of the autograph portrait accompanying this article, the photograph having been presented to Mr. Hammer by the Doctor on the recent occasion of their last meeting. It is a very faithful likeness.

LIGHTING PARADE FLOATS BY STREET RAILWAY CURRENT.

BY JOHN H. BARNARD.

During a trades parade held in Wilmington, N. C., on November 30th, a novel method of lighting was employed on several of the floats. Incandescent lamps were freely distributed about them, connected up five in series. Contact was made with the trolley wire of the Wilmington Street Railway Company by a very simple trolley and with the rails by a little car, made to fit the gauge of the track, which was towed under the wagon on which the float was built. The result was extremely satisfactory, and presents a very simple solution of the difficulty of lighting up floats in night parades. Thirty lights of 16 c. p. gave excellent illumination to large floats. Among the floats lighted electrically was that of the Wilmington Street Railway Company, which represented Benjamin Franklin drawing electricity from the clouds. The kite was attached to a long bamboo pole, and above the kite, and hidden by it was a large contact shoe made of sheet copper. Along the pole, which was carefully covered, were strung fourteen 16 c. p. lamps, representing the string, and the fifteenth was dropped into the Leyden jar. This float, being built on a flat car ordinarily used for construction purposes, the ground connections were easily made through its wheels. This method of lighting proved so satisfactory that no doubt every float of any consequence will be so lighted in the parade of next year.

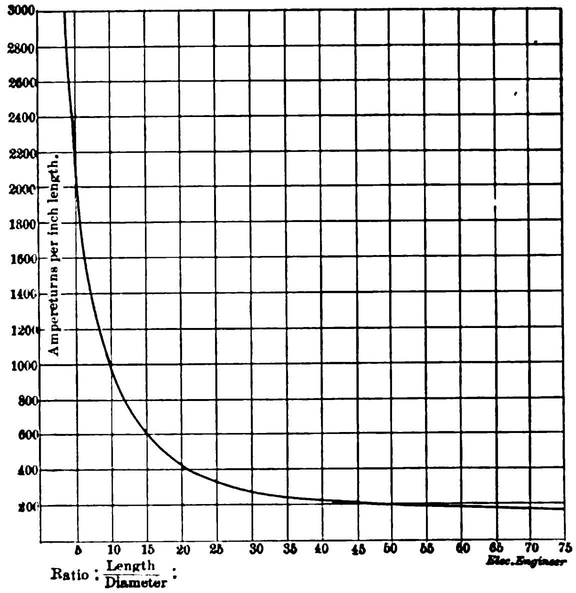
A CURVE FOR ASCERTAINING THE AMPERE-TURNS REQUIRED FOR MAGNETIC SATURATION.

BY

Chas. Steinmetz.

In response to inquiries which are frequently addressed to the writer and in view of the importance of the subject, he has thought that a few words on the ampere-turns required to magnetically saturate a piece of iron of known diameter would prove of value to the readers of The Electrical Engineer.

The ampere-turns required to bring an iron piece practically up to magnetic saturation, can not be expressed as a numerical value, since they depend mainly upon the size and especially upon the *shape*, of the iron piece. In a closed ring, or a rod, the length of which is more than one hundred times its diameter, a M. M. F. of 150 ampere-turns per inch length of the iron piece will, with ordinary good wrought iron, bring the magnetization up to within 10 per cent. of absolute saturation.



With shorter rods, very much larger M. M. F.'s are required, and the M. M. F.'s required depend much more upon the dimensions of the iron-piece. Approximate values of the M. M. F.'s, in ampere-turns per inch length of the iron piece, are given for the different values of the ratio: $\frac{\text{length}}{\text{diameter}}$ of iron piece, in the accompanying curve, though these values can be considered only as first approximations.

A NEW ELECTRIC LIGHT PLANT FOR ST. LOUIS.

St. Louis is to have a large new electric light station. Plans have been approved and contracts already let for the machinery, and work will be commenced shortly. All wires will be underground and the entire equipment will be in accordance with best modern practice.

THE ENGINEERING DETAILS OF THE NEW YORK-CHICAGO LONG-DISTANCE TELEPHONE LINE.

BY

Jos. Wetzler.

I.

BRIEF as has been the time during which the telephone has entered as a factor in commercial and social life, its influence on both can be said to be hardly less than that of the telegraph itself. Indeed, if we analyze more closely the extent to which the telephone is used, comparing the number of calls by the telephone with the number of messages sent by the telegraph, it would be found that the proportion is vastly in favor of the telephone. In the early days it was taken for granted, though no reason was assigned therefore, that the telephone would be limited to communication between points within the limits of a city, notwithstanding the fact that one of the early demonstrations of its power was the communication between New York and Philadelphia, and even between points of greater distance.

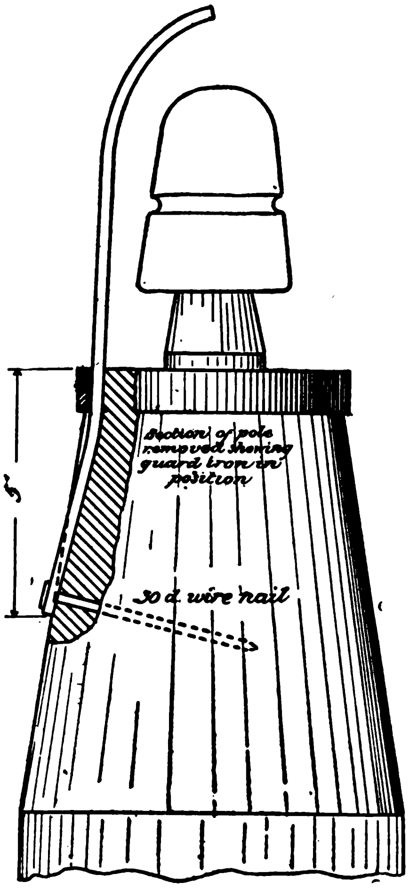


FIG. 2.—GUARD IRON ON TOP OF POLE.

But it was early surmised that if regular telephonic communication were provided between distant cities, and subscribers offered facilities for communication which would involve no more trouble than that experienced in the ringing up of a local correspondent, a business could be built up which could be made profitable. This idea, which had lain dormant for some time, was seriously taken up in 1885, when the American Telegraph and Telephone Company, familiarly known as the Long Distance Company, was organized, and its active management placed in the hands of Mr. E. J. Hall. The first line was built between New York and Philadelphia, and its success was so immediate and spontaneous, that if any doubts had previously existed as to the commercial value of long-distance telephone lines, they were dispelled; and the confidence of the officers of the company in the correctness of their estimates was so strengthened that additional lines between Boston and New York were immediately constructed.

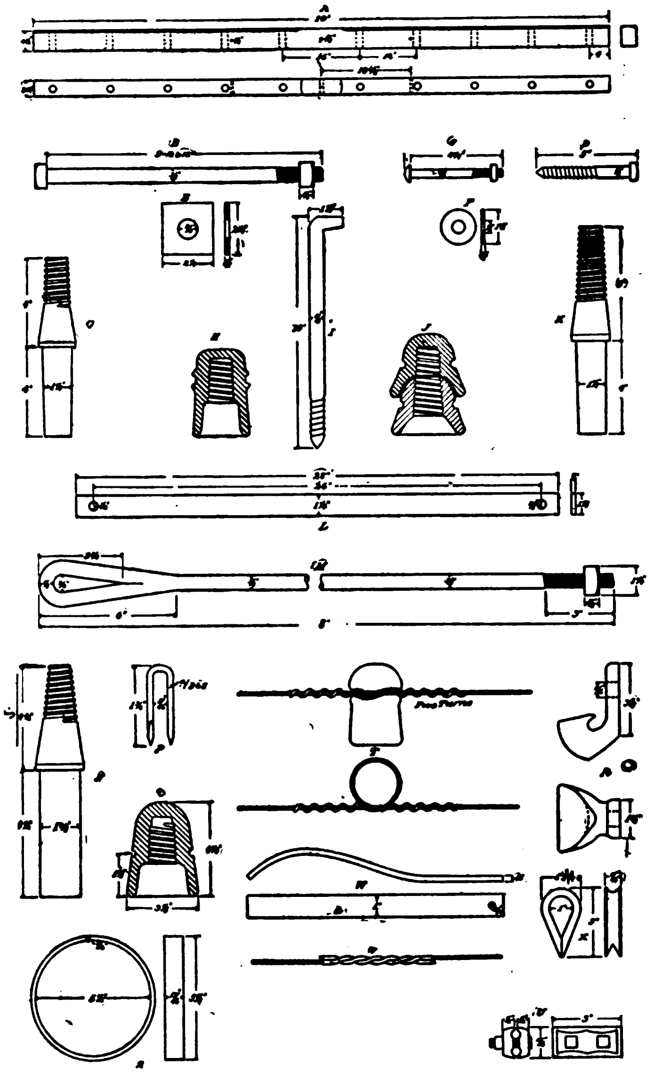


FIG. 1.—DETAILS OF NEW YORK-CHICAGO TELEPHONE LINE CONSTRUCTION.

The history of the development of the long-distance lines since that time is familiar to our readers, and need not be further enlarged upon here, but a recent important addition to which due reference has already been made in these pages, merits more than ordinary attention. We refer to the line recently opened between New York and Chicago, involving a distance of 950 miles, which represents a stride in telephony, the effect of which it is difficult to estimate at this early stage.

II.

Up to the time at which the New York and Chicago line had been contemplated, the longest sustained successful telephonic transmission had been about 500 miles, and it was, therefore, a matter for no small consideration, and one, the importance of which, the company well recognized, that the operation of a line almost twice this distance should be successful at the very start. The previous experience of the company stood it in good stead, but the rules which had been laid down for the calculation of the size of wire required for the transmission of speech had been found to be at such variance with the actual practice of the company, that its engineers were necessarily obliged to observe the greatest caution in their recommendations. The most commonly accepted rule for telephonic transmission is that laid down some few years since by Mr. Wm. H. Preece, chief engineer and electrician of the British Postal Telegraphs, which is as follows :

When $K\ R = 15{,}000$, speech becomes impossible.
" " " $= 12{,}500$, speech becomes possible.
" " " $= 10{,}000$, speech becomes good.
" " " $= 7{,}500$, speech becomes very good.
" " " $= 5{,}000$, speech becomes excellent.
" " " $= 2{,}500$, or under, speech becomes perfect.

This rule, it must be pointed out, is entirely empirical, and as such, as frequently turns out to be the case, is only safely applicable to circuits whose length is within the limits of those by which the rule was formulated. As proof of this we may remark here that the telephone line between Paris and London was built according to this rule, and the $K\ R$ constant of 7,500 was adopted. When the line was finished it was found that transmission over it was very much better than the formula indicated, which went to prove that the rule apparently did not apply to that particular line. But long before the completion of the Paris-London line, it was well known to the engineers of the Long Distance Company, that this rule was not generally applicable, for the reason that the circuits at their command showed that transmission was possible over lines having a very much higher $K\ R$ constant. Thus among the experiments tried by them was the coupling up of lines aggregating in length from 650 to 1,100 miles. The results obtained are shown in the following table :

650 miles, excellent transmission with $K\ R =$ 31,000.
750 miles, good transmission with $K\ R$ = 45,000.
885 miles, poor transmission with $K\ R$ = 62,000.
1,100 miles, no transmission with $K\ R$ = 91,000.

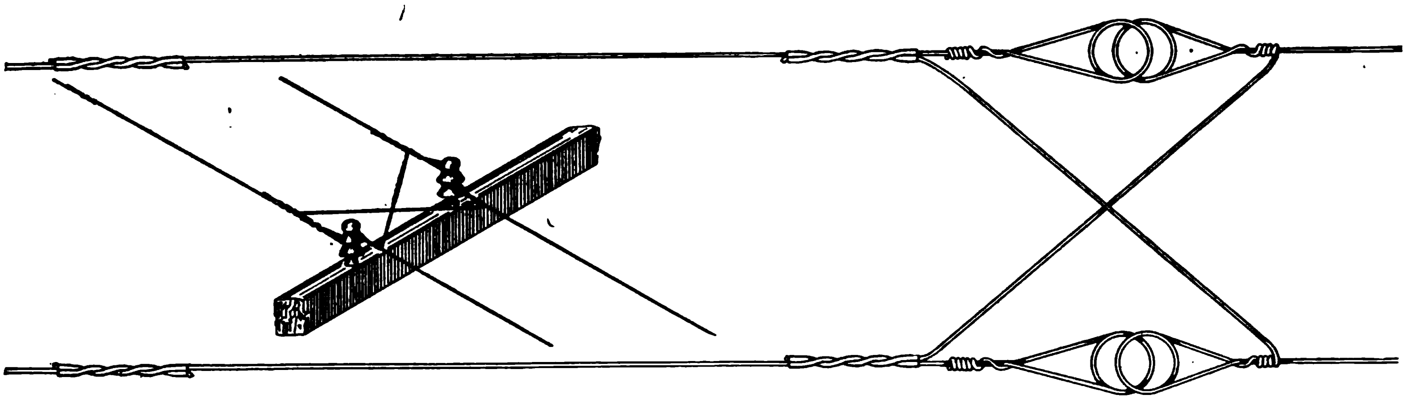


FIG. 5.—METHOD OF TRANSPOSING WIRES, NEW YORK-CHICAGO TELEPHONE LINE.

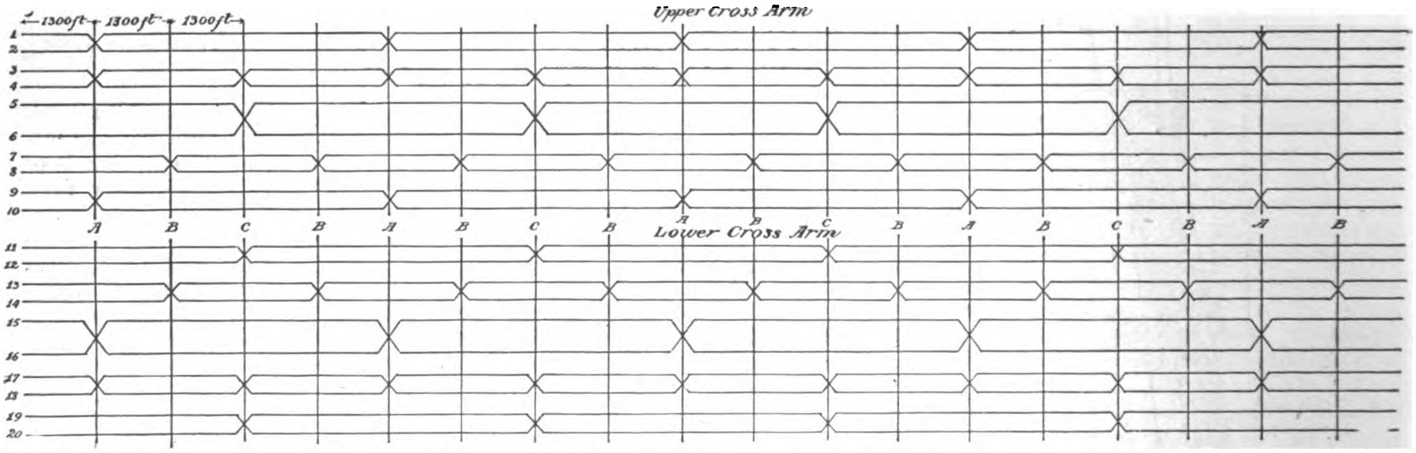


FIG. 6.—SCHEME OF CIRCUIT TRANSPOSITIONS, NEW YORK-CHICAGO TELEPHONE LINE.

These experiments were made with a "solid-back" transmitter, and three cells of Fuller battery, the usual equipment of the long-distance telephone set.

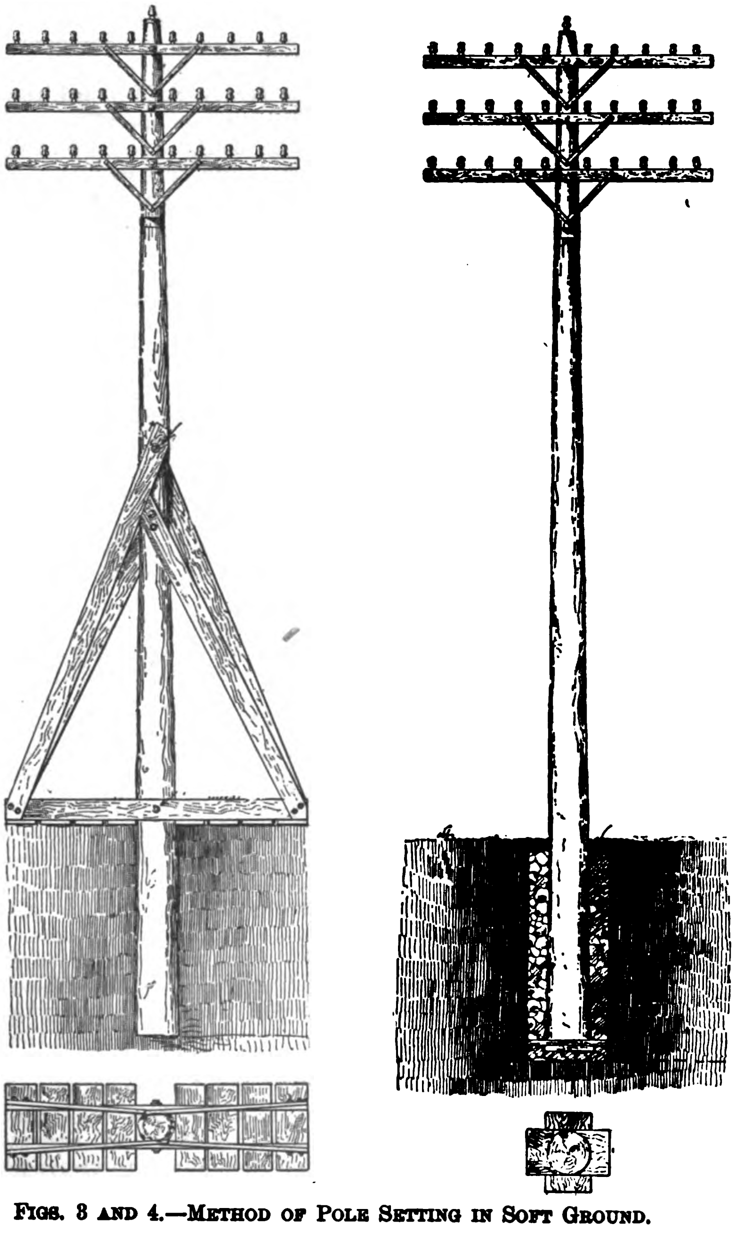
According to the formula enunciated by Mr. Preece, it would require a wire weighing nearly 2,000 pounds to the mile in order to communicate with Chicago, and it was not to be wondered at, therefore, that the engineers of the Long Distance Company hesitated in applying this rule. The results of their own experience, however, was such as to give them confidence in the selection of a greatly reduced size of wire, and after due consideration it was determined to select a No. 8 B. W. G. wire, having a diameter of .165 inch, and weighing 435 pounds to the mile. This wire has a resistance of 2.06 ohms per mile, and a capacity of .0158 microfarads per mile, with wires strung 35 feet above the ground. 1,000 miles, practically representing the distance between Chicago and New York, has a $K\ R$ constant of 32,000. Yet notwithstanding this enormous excess over the limiting figure laid down by Mr. Preece, it was adopted and the line built. The results obtained are now well known, but even before the building of the line was begun the engineers of the company were firm in the conviction that it would prove to have such excellent speech transmitting qualities, that it would give a sufficient margin to make it possible to add on other lines at the end and possibly secure communication to cities beyond Chicago, such as Minneapolis, St. Paul and St. Louis; while, on the other hand, it would leave large margin for the attachment of local lines within a radius of 100 miles from Chicago.

As another proof of the inadequacy of the transmission formula, as laid down, it is only necessary to consider the following $K\ R$ constants for lines which are now, and have been for some time, in daily operation, as follows:

Boston and Washington,	$K\ R = 26{,}250$.
Boston and New York,	$K\ R = 12{,}100$.
New York and Philadelphia,	$K\ R = 2{,}000$.

From the above it is evident that while the lower figures given by Mr. Preece agree thoroughly well with the results obtained on the long-distance lines, the higher figures are greatly at variance with it, the circuit between Boston and Washington, for instance, exceeding Mr. Preece's figure for speech "impossible" by nearly 75 per cent.

As some question might be raised as to the manner in which the $K\ R$ constant is here calculated, it might be well to point out the fact that Mr. Preece multiplies the total resistance of the circuit by the capacity of one of its wires measured against its mate, and estimates that the capacity of one wire measured against



Figs. 3 and 4.—Method of Pole Setting in Soft Ground.

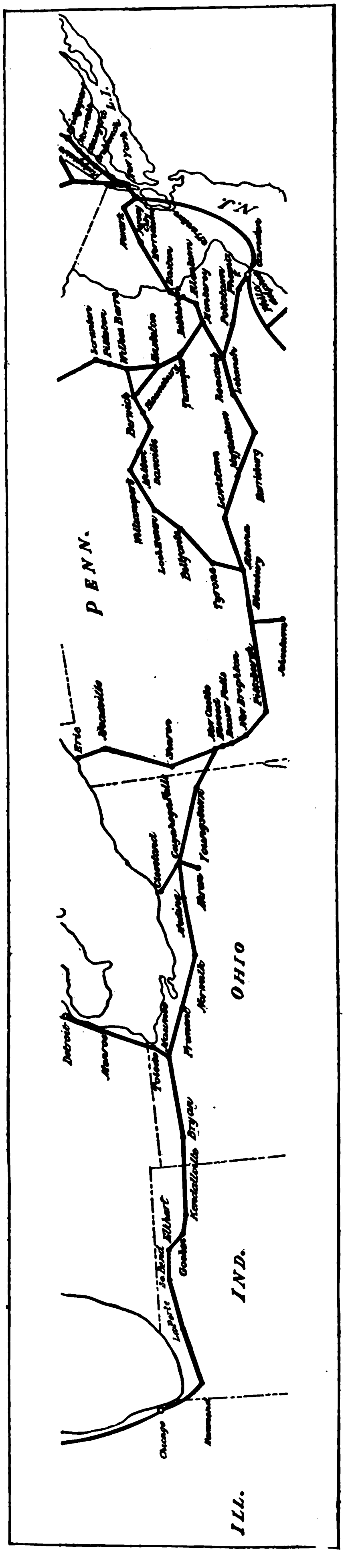


Fig. 7.—Detail Map of New York-Chicago Long-Distance Telephone Lines.

its mate is one-half of what it would be if measured to ground. In the calculations made by the Long-Distance engineers, they have taken the resistance of one of the wires of a metallic circuit, measured in ohms, and multiplied it by its electrostatic capacity measured in microfarads, to ground. The difference evidently is one of method only, the result being the same. It might be well to point out here that one wire measured against its mate, as done in the calculations of Mr. Preece, is never found to be exactly one-half of the capacity when measured to ground, being usually found to be from 60 to 65 per cent. of that quantity.

III.

The building of the line having been determined upon, the questions of the details of construction to be adopted were given most exhaustive study. In this respect the experience of the company in its past work has also stood it in good stead, with the result that it is fair to assume, that the construction adopted will afford a line of the most permanent character.

The line is built of standard poles 35 feet long, of the best quality of live, green cedar wood, peeled, and the knots trimmed close. This length of pole permits it to extend not less than 26 feet above the surface of the ground.

The cross-arms employed are of thoroughly seasoned, straight grained Norway pine, 10 feet long, 3½ inches thick, and 4½ inches deep, as illustrated at A in the diagram Fig. 1, which shows the auxiliary details of construction complete. These cross-arms are given two thorough coats of metallic paint, and are braced with two galvanized iron braces, shown at L, Fig. 1, which are attached to the cross-arms by means of galvanized iron carriage bolts, shown at C. These cross-arms are fastened to the pole not in the usual way, by means of fetter drive screws, but by a galvanized iron bolt shown at B, the pole being bored for the purpose, and the bolt passing entirely through. Washers under the head and nut prevent abrasion of the cross-arms and the pole.

The insulator pins are made of clear split locust, 1¼ inches in diameter, and having the general outline shown at G. The transposition pin is shown at K. The pins are nailed to the cross-arms with heavy galvanized iron wire nails driven in straight from the middle of the side of the cross-arm.

The type of insulator employed is the regular standard white glass American Telegraph and Telephone Company's insulators, shown at H. For the guard wire the 20-ounce Western Union double petticoat insulator, without petticoat, is used as shown at O, Fig. 1. The transposition insulator is of the Hibbard pattern, of white glass, and is shown at J.

On the corner poles guard irons are employed as shown in Fig. 2, and at W Fig. 1, passing under the ring at the top of the pole. Every tenth pole is furnished with a lightning rod made of No. 6 galvanized iron wire. These rods are fastened to the pole every two feet by iron staples extending from the top to the bottom, and at the latter end they are given two hand turns.

In ordinary good ground the poles are set at distances of 130 feet to a depth of 6 feet, and on curves to a depth of 6½ feet. Where the earth is soft so as to prevent proper tamping the constructions illustrated in Figs. 3 and 4 have been adopted.

The method of tieing the wires is shown at T Fig. 1. Here it will be noticed that one side of the tie wire passes around the line wire and makes five complete turns. The joints in the copper line are made with McIntire sleeves, each sleeve being given three complete twists as shown at V, Fig. 1.

IV.

In laying out a telephone line great care must, of course, be taken to avoid cross-talk and other disturbing influences, which militate so much against clear enunciation, and makes wires noisy. For this purpose it is necessary to transpose the wires at proper intervals, and to accomplish this transposition insulators are employed. Fig. 5 shows the method of carrying out the transposition. It will be noted that the line coming from the left is dead-ended on the upper insulator, and continued by means of a cross-over connector to the neighboring line, its mate. This line is also dead-ended on the other upper insulator. In the same way the other two sides are joined so that the position of the conductor on each side of the cross-arm is reversed. The present line carries two cross-arms which will eventually carry 10 wires each, and the transpositions employed on the upper and lower cross arms are clearly shown in Fig. 6.

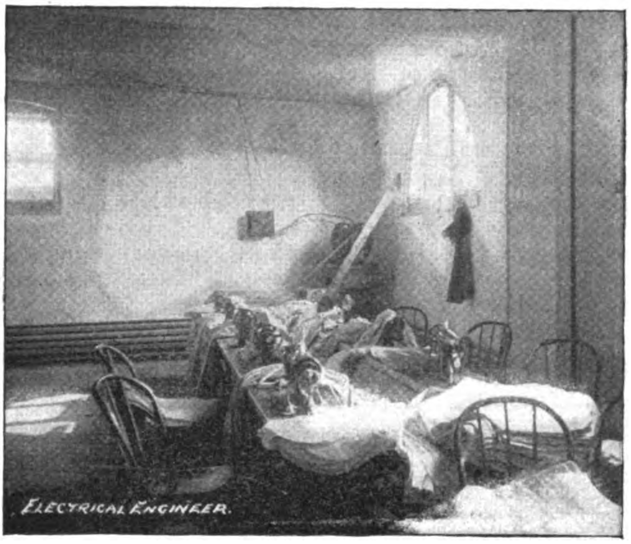
The route over which the line has been constructed is illustrated in the map, Fig. 7. The line, it will be noted, passes through, or is connected by short branches and loops with, the most important cities between New York and Chicago.

We have already referred to the credit which must be accorded to the enterprise and management which has made the New York-Chicago line a possibility, but we cannot close this description without a brief mention of those who have had immediate charge of the work and have brought it to a successful completion. Mr. E. P. Meany, assistant general manager of the Long Distance Company, has had charge of the construction work of the entire line, and F. A. Pickernell, engineer of the company, has had general charge of the electrical and mechanical working out of the system; while Mr. A. S. Hibbard, the general superintendent, has had charge of its operation and maintenance. The company is to be congratulated on the possession of the services of men so thoroughly competent, and whose work will no doubt prove of permanent value to the profession at large.

THE SHERIDAN ELECTRIC POWER AND OFFICE BUILDING, DENVER, COL.

The growth of any city is marked by a diversification of its industries, and the growth is helped, not less than the diversification, by the ability to obtain power readily in small quantities. The number of manufacturers who wish to run a steam plant of their own is in reality very limited, and hence small industries have often been bunched together, under very disadvantageous conditions, in large buildings whose only recommendation was that they could furnish power from some large engine by means of long lines of shafting and belts. Every large city in the Union has such buildings to-day, and their number would go on increasing were it not for the improvement in gas engines and for the still greater revolution or advance effected by the perfection of electric motors and the flexibility of electric power distribution. The result already of the introduction of electric motors has been that consumers of power in small quantities are no longer compelled to herd together in quarters of the city frequently unsuited to their class of trade or product, but can now locate in desirable regions and enjoy facilities of commerce hitherto undreamed of.

The new departure has gone even further, and has already been pushed to its legitimate conclusion by enterprising engineers and capitalists. In other words, we are beginning to see the erection of fine buildings, in choice city districts, where the current generated by a plant in the basement is distributed to every floor and is at the service of every tenant, who can apply it to any work short of the heaviest. As an example of what is now being attempted in this direction, we illustrate the Sheridan Building in Denver, built last summer by Mr. J. H. Ernest Waters, a mining engineer who has done much to promote the application of electricity to mining work in the West. His plants in the Sheridan and Belmont Consolidated mines, in Colorado, have already been illustrated and described in THE ELECTRICAL ENGINEER. His success in the mining field enabled Mr. Waters to turn his attention to real



COLORADO OVERALL FACTORY, SHERIDAN BUILDING, DENVER.

estate, and the Sheridan Building exemplifies his ideas as to what a progressive capitalist can do in any city to encourage the development of the smaller industries which do so much to render prosperity stable and accumulative.

Mr. Waters's plan at the outset was to erect and equip a building suitable for occupancy by such smaller manufacturers as brass finishers, working jewelers, lithographers, platers, photo-engravers, printers, etc., whose business, though requiring power, did not warrant the cost of the installation of and attendance on independent steam plants.

THE WESTERN PLATING AND MANUFACTURING CO.

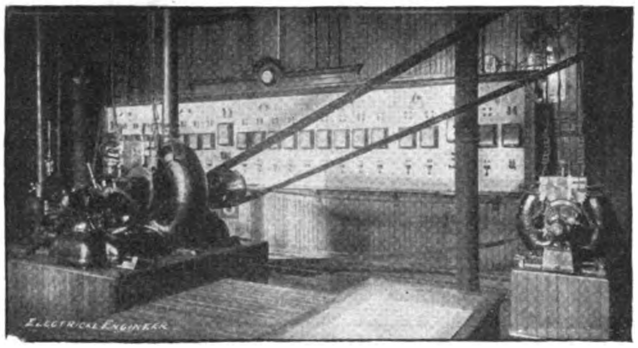
He was ably seconded by Baeressen Bros., leading architects of Denver, and Mr. H. L. Lufkin, of New York, who designed and drew up the specifications for the electrical plant, switchboard, and distributing system. The entire electrical equipment was furnished by the C. & C. Electric Motor Company. The building is shown on page 570. It is in a thriving quarter of the city, and would do credit to any thoroughfare. There are four floors.

The generating plant consists of a Frazer & Chalmers Corliss engine of 150 h. p. capacity, and a Straight Line engine, high speed, of 40 h. p. capacity. There are foundations in the engine room for two 50 kilowatt dynamos, only one of which, however, has thus far been installed. The 50 kilowatt dynamo is used through the daytime for operating both the power and lights all over the building, and is wound for a pressure of 115 volts. It is driven from a countershaft which in turn is driven from the 150 h. p. engine.

Directly connected by belt to the 40 h. p. Straight Line engine is a 20 kilowatt dynamo used for lighting after the large engine is shut down at about 5 or 5.30 p. m. The stores in the front of the building are thus furnished with light until 11 or 12 p. m., as the case may be; and such hall lights and small powers are furnished as are required for overtime work. The switchboard arrangement is such that the small dynamo is thrown on or off the power circuits as well as the lighting circuits, as conditions require.

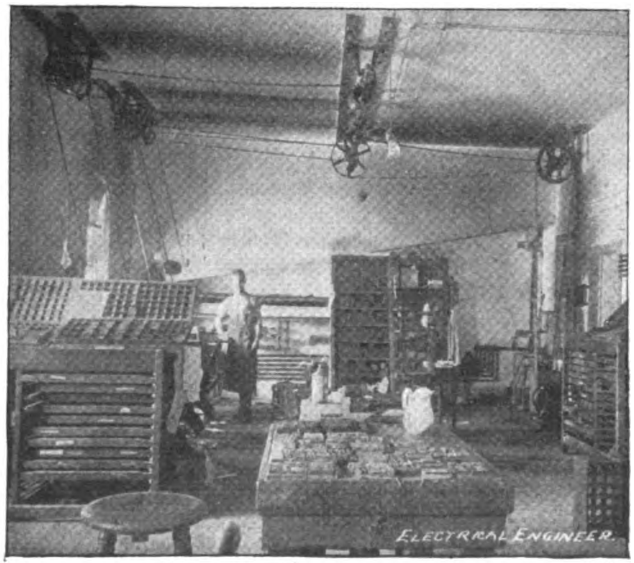
The boiler plant comprises two 60 by 16 Frazer & Chalmers tubular steel boilers.

The marble switchboard is a very handsome piece of equipment about 15 or 20 feet long, with an independent power



PART OF THE DYNAMO ROOM.

circuit arranged from the switchboard to each tenant in the building, thus giving the engineer at all times the opportunity of checking off the power that is used by each tenant. Observation of the general action of the indicator needle also enables him to detect the development of any trouble, and gives the ability to locate and remedy it. The



QUEEN CITY PRINTING CO.

building is wired throughout with American Electrical Works triple braid wire strung on porcelain insulators.

On the ground floor of the building are situated also a number of large stores, with which the generating plant in no wise interferes. One of the stores is occupied by the Kennedy & Pierce Machinery Co., extensive dealers in mining and other apparatus; Anfell & Co., druggists; a large grocery firm; and by the "Nomad" saloon, which prides itself on being the most gorgeous bar in a city where excellence of the kind is far from uncommon. We mention these branches of trade and "industry," and those which follow, in order to indicate clearly the variety of work to which the power furnished is being applied. On the second floor are the offices of Waters Bros., mining and mechanical engineers; the Beebe Engraving Company; the Denver Printing Ink and Roller Works, and a room occupied by the Columbian Exposition Commissioners. We illustrate some of the rooms on the various floors, our engravings showing a plating establishment, a printing office and an overall factory. One or two others would have been illustrated, as good examples, but unfortunately—or fortunately—the motors are not so much *en evidence* in them. Electric motors are such handy things for stowing away in awkward places, that the temptation to "hide their light under a bushel" cannot be resisted. At the time the data was given us for this article there were 15 large airy rooms ready for occupation and being rapidly rented. They range in size from 18x60 feet to 20x90 feet, and each has its 5 h. p. motor, electric light, artesian water and steam heat. Any tenant requiring more power can of course get it in just such units and quantities as are necessary to drive the machines or tools. The motors are run from 7 A. M. until 6:30 P. M., under the terms of the lease, and special, easy arrangements are made for tenants needing power at night. There are two electric elevators in the building, one for freight, serving the railroad tracks on the north side of the building, and the other serving to deliver manufactured goods to wagons on the south side of the building. There is thus every facility for handling raw material and the finished product.

The Sheridan Building immediately adjoins the Union Dépôt and is at the foot of one of the principal business streets of the city. The present tenants express themselves as well pleased with the location and arrangements of the building, and we cannot but believe that such facilities must draw to Denver from the East and elsewhere many promising young industries in search of power and a market. It seems to us, also, that Mr. Waters has made an innovation in which he should find many imitators, for it is no longer necessary to preach the benefits of electric power. The question nowadays is that of distributing and furnishing the power to those who ask for it. We have shown above one admirable way of solving the problem.

THE SHERIDAN BUILDING, DENVER, COL.

IS THE ELECTRIC DISCHARGE OSCILLATORY?

IN the experiments by Hertz, on electrical oscillations, and also in the experiments of subsequent investigators in the same field of research, Ruhmkorff coils have been used to propagate the electrical oscillations. It is well-known, however, that the oscillations in the sparks from a Holtz machine or a Leyden jar are far more rapid than those produced by the aid of a Ruhmkorff coil. Töpler, therefore, has endeavored to study electrical oscillations by the aid of a Töpler-Holtz machine, and with success. During his experiments he was led to examine the electric spark between a conductor and a surface of water, and he discovered that a spark under these conditions does not oscillate. He has therefore deduced the conclusion that it is extremely probable that the ordinary lightning discharge does not oscillate. A loud noise and a strong development of light in an electric spark are held by Töpler to be not, in general, criteria of the oscillatory character of the spark.

THE PROPOSED INTERNATIONAL ELECTRICAL EXHIBITION IN MILAN.

WITH regard to this proposed exhibition in 1894, the committee are now proposing to offer, in addition to the usual diplomas and medals, a "grand premium" for the most important invention and discovery in the field of electricity, having special regard to the long distance transmission of electric energy, and its distribution and transformation for industrial uses.

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Nature is our kindest friend and best critic in experimental science, if we only allow her intimations to fall unbiased on our minds.—Faraday.

IS IT TO BE A RAREE SHOW?

IT has appeared from the statements of the electrical authorities of the World's Fair that the demand for space has led to the cutting down of the allotments asked for by exhibitors at home and abroad. From this fact, it might be inferred that the electrical display would be very fine; and the inference is true, but unfortunately, no small part of the space has been awarded to exhibits either of the raree show nature or to those that are in reality in the line of quack medicines. Some of them have been called "swindles." Admitting the good faith of the proprietors of these nostrums, it still seems to us to be an imperative duty on the part of the World's Fair administration to rule out such exhibits peremptorily. To give these exhibits a place at all, is official recognition of their validity and value.

If necessary, we shall specify later on the exhibits we refer to, though the management, with men like Prof. Barrett and Dr. Hornsby at the helm, ought to know them without any assistance. To show how the space is wasted, we will quote from one exhibitor of electric belts, etc., who says: "It is intended to show in addition to a complete line of our goods, the manufacture of the same. We intend to put in a full line of operators on our machines, and we shall turn out our completed articles in our exhibit." Another concern of the same character says: "Our work is devoted entirely to this line (magnetic shields) and the goods are what are known as vests, belts, insoles, etc. In our exhibit *we do not intend to show anything in the line of electricity*." But the most curious avowal of all is that of a Chicago doctress or "electric surgeon," who writes: "I will exhibit samples of my work—old women, with one side of the face young." Her invention is the eradication of wrinkles by electricity and her circular says: "I will remove wrinkles and crow's feet from one eye for any one free of all charge. You are under no obligation to have any more work done unless you so desire." As one generally does pay to be shaved on both sides of the face, at once, it seems likely that one would desire to have the environment of both optics rejuvenated at the same time. But such curiosities as these belts, shields, insoles and rows of ghastly old women are out of place among the regular exhibits of an educational exposition, and we suggest that they be relegated to the position of "side shows" beyond the grounds, or else be turned over to Barnum, Hutchinson & Bailey's Greatest Show on Earth.

ECONOMY OF ALTERNATE CURRENT PLANTS.

In a communication printed in another column, the manager of a small central station raises a very important question, in reference to the commercial efficiency of the alternating current plant as a whole, which has not hitherto received the attention it merits. While in the transactions of the learned societies and in the columns of the technical press, there has been no lack of able papers, and of no less able discussions upon the conditions of maximum economic efficiency in dynamos, in transformers, in lamps, and in conductors, yet the question of the economical conditions affecting the alternate current system with transformers as a whole, appears to have been almost completely neglected. It is now something like six years since the first commercial plant of this kind was installed in this country; many hundreds of them are in operation in all parts of the United States under almost every conceivable condition, and yet strange to say, the figures given by our correspondent are, so far as we are aware, the first which have been published giving the results of actual every-day work in a small station. The fact that these figures are distinctly unfavorable, does not necessarily prove that the system itself is at fault, but it does show that it is liable to unsuspected and hidden sources of loss, amply sufficient to account for the not infrequent financial failure of electric lighting enterprises which ought to be profitable, but are not. We shall welcome further communications on this subject, especially those containing facts and figures deduced without prejudice from the results of actual commercial work. As we have more than once pointed out, the margin of profit in electric lighting is still too small at best to admit of any avoidable waste or loss.

LONG DISTANCE TELEPHONY.

Regular and steady users of the telephone fail to realize what an important rôle it has already begun to play in daily life, and it is only when some new feat in telephony is accomplished such as the opening of the New York-Chicago Long-Distance line, that we are brought face to face with the fact that telephony is a progressive art with well defined stages of advance. This applies not only to the exchange apparatus but to that important branch of the service, the underground and overhead work. While the methods which have insured the success of intra-urban telephony were pretty clearly worked out some time ago, the establishment of communication between distant cities has been a work requiring the utmost caution in order, first, to attain good, commercial talking, and, second, not to exceed an investment which would leave a reasonable margin of profit. Taking the New York-Chicago line, for instance, an increase of thickness in the wire of only $\frac{1}{100}$ of an inch would have involved an increase in cost amounting to over $15,000. The laws of calculation as laid down, and generally accepted, if applied in this case, would have made the cost utterly prohibitive.

THE LIFE OF INCANDESCENT LAMPS IN ITS RELATION TO MERCURY AND METALLIC VACUUM PUMPS.

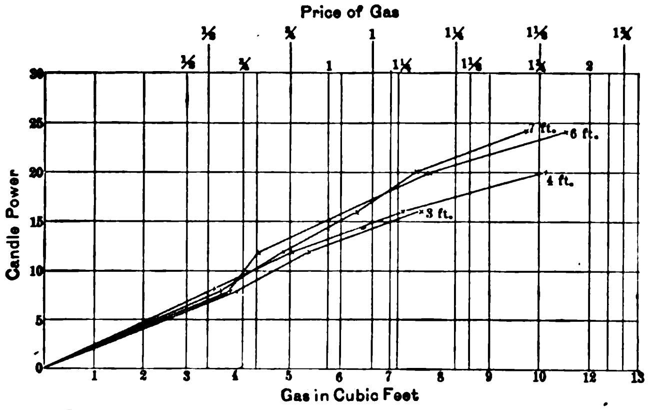
BY

G. A.

THE paper read by Prof. B. F. Thomas at the last meeting of the American Institute of Electrical Engineers has been criticised by incandescent lamp makers, by the gas interests and by the press. From the lamp makers' point of view, the paper is certainly worth more than average consideration. The three points brought out are:

1. That the so-called 16 c. p. lamp gives only 14½ candles. 2. That the efficiency is at least half a watt less per candle than claimed by the companies. 3. That lamps exhausted by means of a metallic pump showed less blackening than those exhausted by mercurial pumps.

To begin with the criticism of the daily papers and the gas companies, the *Boston Transcript* of July 26, said that "the gas-light interest has always maintained that the candle power of the incandescent electric lamp is not what it is represented," and these tests "as the gas people contend, do not justify any maker of carbon-filament lamps in saying he can give 12 lamps of 16 candles each to the electrical horse power." Of all interested in the matter the gas companies should not be amongst the first to throw stones. It is a well-known fact that no gas company does furnish the candle power claimed per cubic foot of gas, and to find out how near these companies come to their claims, the writer made some tests of which the accompanying diagram and tables show the results. There is practically nothing new in the matter.



Pressure 1¾ inches Time 8.30 to 11.30 A.M. August 13th 1892.

FIG. 1.

TABLE I.

Burner tip feet.	Candles.	Gas per hour. Cubic feet.	Candles per foot.
2	5.75	5.53	1.03
3	9.8	5.5	1.78
4	11.1	5.	2.2
6	13.	5.5	2.36
7	13.3	5.18	2.56

The diagram Fig. 1, includes the price of gas at the rate of $1.50 and $1.75 per 1,000 cubic feet. The burners were of the common kind most generally in use, and the time, 8.30 to 11.30 a. m., was selected because, on account of the lower pressure, it must be more favorable for the gas interests. The tests in Table I. were made with the "Champion" regulating burner which is indorsed by the gas people. The burner was regulated for 5 feet of gas, but 2, 3, 4, 6 and 7 feet tips were used with it. The benefits of this burner are claimed to be reduced gas bills and complete combustion of the gas. As the burner is regulated for a certain maximum flow of gas per hour the gas bills should certainly be smaller than without the regulating device; as to the amount of light produced per cubic foot of gas the reader may judge for himself. The gas pressure outside of the regulating burner was $2\frac{3}{16}$ inches and the time 8 to 10 p. m.

Table II. shows the ordinary burner with the gas at the same pressure. We find that the conditions are not improved to any extent by the use of regulators. The best results give us 2½ candles per cubic foot of gas, while the gas companies claim $3\frac{8}{10}$. The tests may be criticised from a scientific point of view, but they show exactly the state of things at the consumer's end of the gas pipe.

TABLE II.

Burner tip feet.	Candles.	Gas per hour. Cubic feet.	Candles per foot.
2	11	10.9	1.
3	16	10.6	1.5
4	18	10.4	1.74
6	28	14.6	1.92
7	31.25	15.1	2.

Comparing the price of incandescent lights with gas, candle for candle, we find it about even at $1.75 per 1,000 feet of gas on the one side and 1 cent per 50 watt hours (the usual charge) on the other. The light from a 50-volt lamp of 55 watts will cost the consumer 1 cent per 14½ candles, while from a 100-volt lamp of 60 watts it will cost 1 cent for 13¼ candles. If less efficient lamps are used, the consumer of course has to pay more for his light, and this leads us to the question of efficiency.

When the consumer puts in the electric light he expects more light for less money than he paid for gas; in rare cases he puts it in as a matter of luxury and even where this happens it will be a question of dollars and cents in the end. Therefore lamps of high efficiency should be used; such lamps however can only be run satisfactorily where great care is taken to keep the voltage constant. Whenever an investigation is made on a complaint of lamps not lasting long enough, it will be found that they are run above voltage.

It must be admitted that a lamp of four watts per candle will stand the variations better than one of three and one-half watts, but to compete successfully with the old-established gas-light, in regard to price, the more efficient lamp should be used, and the consumer who pays by the meter will find it the cheapest in the end, even if it should burn out after 300 hours' use, while station managers where light is furnished by contract, will find their coal bills reduced. At the rate of one cent per 50-watt hours the consumer pays at the end of 300 hours $3.30 if he is using a 55-watt lamp; using a 60-watt lamp he pays $3.60 for current, and $3.90 if his lamp should take 65 watts (4.1 per candle). Thus, enough is saved every 300 hours to pay for a new lamp. But the prospects are that as long as only the life of a lamp is considered, the efficient lamp will not find many friends. There are still too many who point with pride at the lamp that burned 5,000 hours, though it only gives about three candles. Lamps that have been in use 1,000 hours drop 50 per cent. in candle power, as has been shown by Prof. Thomas, and to obtain satisfactory illumination, and, considering the present low price of lamps, should be replaced by new ones when they drop below 12 candles.

This loss of candle power and the blackening of the lamps have been variously explained from time to time, but we are still in the dark. The latest theory is the presence of mercurial vapors in the lamps which are utilized by carbon particles as a medium of transportation to be safely landed on the inner walls of the bulbs. What become of the carbon particles in lamps which contain no traces of mercurial vapors is not made clear; like good carbon particles, they probably stay at home. Neither has it been explained why some lamps exhausted by means of a metallic pump blacken in spite of the absence of mercurial vapors. Experiments made in this direction show that filaments surrounded by mercury vapors will turn black and drop in candle power while the bulbs remain clear.

Supposing the heat given off by the filaments during the burning process should aid the volatilization of the mercury in the pumps, could the vapors, in the very short time the mercury is at its highest point, reach the lamps? Mercury vapors may rise to a height of over 36 inches while the distance between the check valve of the ordinary Geissler pump and the top of the fork is somewhat less than 30 inches; but as the mercury is constantly in motion it is hardly possible that the vapors would rise to their greatest height. If there are such vapors, their effect would be in the pump only, but no trace would be found in the lamps. The effect on the lamps, however, might be indirect.

If one will take the trouble to inspect burned-out lamps in quantities, collected from different places, he will find that the larger the candle power, the greater the blackening; this is especially the case with lamps made by two of the oldest companies. In many cases 50 c. p. lamps are discontinued on account of excessive blackening. Now, why do the high candle power lamps blacken more than the others? The filaments are usually made the same way, and the lamps treated the same way on the pumps.

Supposing we accept the mercurial vapor theory in part; we might then account for the blackening in this way: When the lamps on the pumps are sufficiently exhausted and the current is turned on, the gases contained in the filament are set free. At the start these gases are readily taken off by the pumps, but as the process progresses the amount of gas diminishes while the heat increases and causes mercury vapors to rise; then these vapors, though only a short distance above the body of mercury, may rise sufficiently to prevent the lighter gases from the filaments from escaping through the pump. Thus we may have a residue of gases on the one side and a perfectly empty pump on the other. On cooling off, these gases will be absorbed again by the filament, and when the lamp is opened under mercury it will show as near a perfect vacuum as may be obtained with any pump, mercurial or metallic. But in the course of time these residual gases, by the action of the current, will increase, if not cause, the gradual disintegration of the filament and in this way blacken the bulb. The large outlet in the metallic pump may take the gases off more readily than the mercurial pump, but the oil vapors throughout the system of piping may also prevent the lighter gases from escaping; if not, why is it that some of the lamps exhausted with a metallic pump do blacken? As the blackening is undoubtedly one of the consequences of the natural disintegration of the filament, and the residual gases are one of the causes, the writer has modified the ordinary Geissler pump in such a way as to have a continuous suction and thus not only shorten the time but take the gases off more readily and also prevent possible mercurial vapors from rising. Lamps exhausted with this pump show very little blackening after 500 hours' use.

The blackening of lamps will probably never be satisfactorily explained, but it is a problem worth studying, and lamp makers should do all in their power to reduce it as much as possible. If it can be proven that the lamps exhausted with the metallic pump do not blacken while all others do, then let us discard the mercury pumps; until then, however, we had better remain true to this old friend, whose advantages, thus far, outweigh the disadvantages of the other.

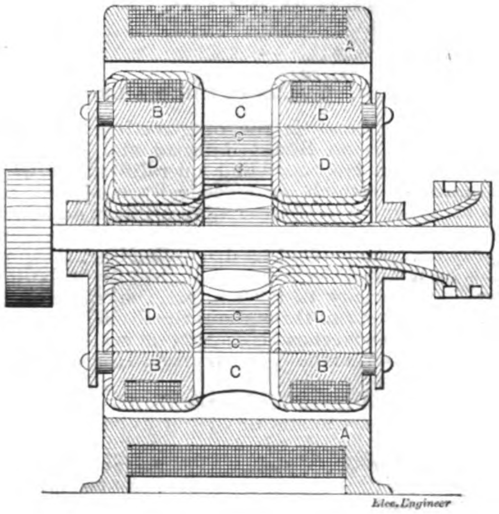
ON A NOVEL TYPE OF UNIPOLAR MACHINE.

BY

Wm A. Carey

I HAVE read with interest the several articles in THE ELECTRICAL ENGINEER on the unipolar dynamo, and would like to contribute a trifle on the subject.

Mr. Balch has mentioned two characteristics of the so-called unipolar dynamo, which are undoubtedly worth considerable study and experiment (uniformity of direction and strength of current) inasmuch as, judging from analogy, hysteresis and self-induction would probably not obtain to any appreciable extent if the current action could be maintained at normal without fluctuation or change of sign. Mr. Balch also says that the main difficulty with the type of machine shown by him is, that the conductor cannot be coiled, which, of course, would be necessary to raise the potential. But I believe it probable that the winding and proper movement of conductor can be accomplished in a differently designed apparatus. I say movement, because Mr. Balch actually obtains no movement whatever, either of conductor or field of force, as Mr. Steinmetz very clearly demonstrates in the ENGINEER of October 5, and a rotation of the magnet does not carry the magnetic field with it; consequently no change takes place in the relative position of conductor and lines of force.



THE CAREY UNIPOLAR MACHINE.

Mr. Steinmetz states that no E. M. F. exists in the conductor W, but is limited to the "inside conductor, the magnet M S itself." It would seem, however, that the electric current implied by the observed E. M. F. must complete its circuit through the conductor to be observed at all, or, in fact, to exist. Faraday is clear in his description of the experiment in question, and the machines of Forbes and Delafield produced large currents, but no attempt to realize high voltage has succeeded under this method of induction, as far as I can learn.

As the machines mentioned actually gave a large output of energy and manifestly moved their conductors in a uniform field of force, is it not possible that the difference of magnetic intensity between the two points of contact of the conductor with the magnet (at the pole and at the neutral point) may offer a promising field for exploration?

When a description of Forbes' dynamo first appeared about six years ago, the writer, with a desire to control the factor of E. M. F. in a machine designed on the same lines, worked out the details below, which are submitted to such of your readers as have given thought to this interesting phase of inductive effect. I have never had an opportunity to demonstrate this idea practically, but have talked it over a good deal with able experimenters, including Mr. Tesla, without discovering any reason why it should not accomplish its purpose.

Reference to the accompanying sketch will show Faraday's experiment carried out as far as moving a wire in a horizontal plane through the lines of force between maximum and minimum magnetic strength is concerned. It is clear that if the wire is wound close to the iron of the armature, both inside and outside of the ring, the current would be generated in the same direction on each side, and thus would neutralize itself; but if the inside portion of the coil is carried away towards the centre of the armature, there would be a differential effect in one direction, the strength of which would, without doubt, be proportional to the square of the distance between the iron ring and the inner side of the helix. The amount of resistance or length and size of wire necessary for a given E. M. F. would probably be governed by the same formulæ as in ordinary armatures, with perhaps some modification on account of the influence of the distant ring. The magnetic lines would, however, be well contracted between armature and field.

The following explanation will make clear the details of construction:

A is an annular magnet, wound simply to render the whole of each side of an opposite polarity. B is also an annular magnet so wound as to give opposite polarity from that of the field. This armature is in reality two rings joined together with spokes of iron, cast with the rings, so that the wire may be wound in opposite directions on each half and still possess only two poles; the wire may be wound on one-half of the armature until full, and then merely carried across and wound on the other half, bringing the two ends to a collector.

C C are the iron spokes or connections. D is a non-magnetic material, such as wood, etc., which is used so that the inner wire shall not be subject to magnetism. No supports for the shaft and armature are shown.

Will this machine generate a current, and if so, will there be the usual phenomena of hysteresis and self-induction? Would the absence of these two factors compensate for the large amount of dead wire involved in this design and show fair efficiency?

ELECTRIC RAILWAY DEPARTMENT.

THE BINGHAMTON, N. Y., ELECTRIC RAILROAD COMPANY.

THIS interesting road is the outgrowth of the consolidation of the Binghamton Street Railroad and the Binghamton and Port Dickinson Railroad, and operates about 22 miles of road, 10 miles of which is electrically equipped while the other 12 is at present operated by horses. It is now proposed to equip the entire road with electricity and bonds are being issued for that purpose. An acre of land on the river, in the heart of the city has been purchased, upon which will be built a power house having a capacity of 1,400 h. p. The tracks are being relaid with 72 lb. girder rail throughout the town and 48 lb. tee rail in the suburbs. The overhead construction is also under way and contracts have been made for Thomson-Houston motors and Stephenson cars.

Three and one-half miles of the Binghamton Street Railroad, operated before the consolidation by horses, has since been equipped with electricity an affords and interesting example of the relative merits of the two systems. The earnings shown for this section, using three cars drawn by horses, from Oct. 13 to Nov. 9, 1891 were $538.55, while from Oct. 13 to Nov. 9, 1892, electrically operated, the earnings were $1,264.80. A comparative table, showing the earnings under the same conditions and with the same number of cars, for the first two weeks operated by horses and the last two weeks by electricity shows:

Sept. 29 to Oct. 13, 1892, horses	$322.60.
Oct. 13 to Oct. 26, 1892, electricity	680.30.

Mr. W. J. Clark, expert and general agent of the railway department of the General Electric Company, has submitted an exhaustive report upon the road from which it appears that the average gain in earnings for the year 1891 over 1890 was more than 33⅓ per cent.

The officers of the company are G. T. Rogers, president; John Evans, first vice-president; Hon. J. B. Landfield, second vice-president; C. O. Root, secretary; J. B. Rogers, treasurer; J. P. E. Clark, manager, and S. E. Monroe, engineer.

THE PASADENA AND SIERRA MADRE RAILWAY.

ONE of the most comprehensive systems of mountain railway in the world is contemplated by capitalists at Pasadena, Cal.; namely, the building of a railway, part cable and part trolley, from Altadena, the last station of the Los Angeles Terminal Railway Company's lines, to the summit of Mount Wilson. Hourly communication will then be afforded between the highest peaks of the Sierra Madre and the coast, thirty miles distant.

The first portion of the mountain road proper will be erected against the southern flank of the most conspicuous promontory of the entire Sierra Madre Range, starting from the base of Rubio Cañon. This will consist of a double-tracked cable road, with balanced cars and safety appliances, and will be operated with a stationary electric motor, power being furnished by a neighboring waterfall. This cable will be superior in strength and capacity to those used on Mt. Vesuvius, the Island of Hong Kong and the Lookout Mountain, in Tennessee. From this point the second division of the road takes its start. The surveys for this have disclosed a line of less than seven per cent. grade along natural ridges and curves clear to the highest summit desired. This grade admits of the construction, immediately below the crests and in the face of the range itself, of about six miles of road. These will be operated by electrical power, and supplied with Pullman double decked cars. The first section, it is expected, will be completed by the early autumn while the construction of the second, or Electrical Mountain Railroad division to the summit, will follow the completion of the cable without delay.

From comparison with the mountain railways already constructed both in this country and abroad, Prof. T. S. C. Lowe, of Pasadena, the originator and prime mover in the enterprise, anticipates a large and profitable business.

The latest official returns from the Mt. Rigi R. R., Switzerland, for instance, give a total net receipt of $100,000. It carried one hundred and twenty-nine thousand five hundred and forty-three passengers and conveyed four hundred and fifty tons of passenger baggage, and one thousand two hundred and fifty tons of other goods. Over four hundred thousand passengers are annually carried between Pasadena and Los Angeles.

The road is capitalized at $600,000.

THE GARTON LIGHTNING ARRESTER FOR ELECTRIC RAILWAYS, ETC.

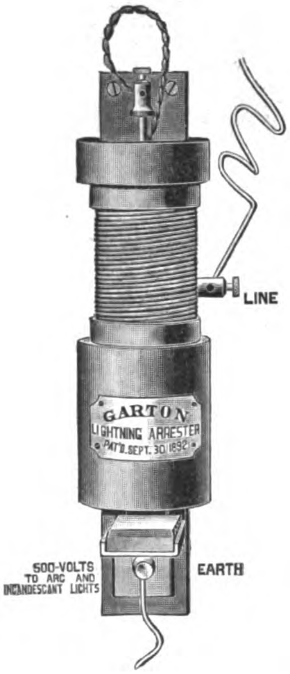
A RELIABLE lightning arrester is now recognized to be an indispensable adjunct to all electric railway and power circuits, etc., and hence a simple device of this character which has given good results in actual practice will be of interest to station managers.

The Garton lightning arrester which is illustrated in the accompanying engraving consists of a coil of wire wound upon a spool of non-conbustible material. Below this coil is an air chamber of the same material as the spool and forming a part of it. In this air chamber and resting upon a carbon plate which forms the bottom of the air chamber, is an armature fastened to a guide-rod which is made of non-magnetic material, but is a good conductor for the passage of the discharge. The centre of the coil being hollow, the armature and guide-rod can rise and fall the full length of the coil.

The guide is fastened to a flexible conductor (by means of a binding post which is a part of the guide-rod) which goes to the inside end of the coil; and the outer end of the coil terminates in a binding post, which may be attached to the line wire. At the lower end and just beneath the air chamber is another carbon plate with a serrated surface toward the first carbon, forming the bottom of the air chamber.' This lower carbon plate may be adjusted at any desired distance from the upper plate, thus at will varying the air space, as may be desired. This carbon plate is held in place by means of a bracket, to which is attached a binding post to which the ground wire is connected. Thus when a static discharge takes place the lightning enters the binding post, marked "line," thence passes through the coil, the flexible conductor to the armature and guide-rod, through the guide-rod and armature to the carbon plate forming the bottom of the air chamber and upon which the armature is resting, across the air space to the lower carbon plate and into the earth.

The passage of the lightning across the air space produces an arc through which the generator current flows to the ground, forming a dead short circuit. The flow of current through the coil energizes the coil which instantly draws the armature into it, thus raising the armature from its contact with the top carbon in the chamber and establishing an arc in the air chamber. The air chamber being closed at the top by the rising armature and the oxygen in the air chamber being consumed, the arc is destroyed, and the current ceases to flow. The coil being thus deprived of its energy, the armature again falls of its own weight to its resting place in readiness for another discharge, the whole process occupying a fraction of a second.

It might be thought that the coil offers some resistance to the passage of the lightning, due to its self-induction, but it is claimed not to offer any more than a straight conductor of the same cross section and length, for the reason that the core or armature is not inside the winding until after the passage of the lightning. It will be noted that the construction here adapted involves no pivots or hinges and as a matter of fact the arrester requires no attention, whatever, resetting itself automatically after each discharge. Each one is thoroughly tested by Leyden jar discharge before being sent out.



THE GARTON LIGHTNING ARRESTER.

These arresters which are built by the Garton-Daniels Electric Co., of Keokuk, Iowa, have been in use for some time on railway and lighting circuits, and are claimed never to have failed to protect in a single instance.

STILLWATER AND MECHANICVILLE, N. Y., STREET RAILWAY.

THE STILLWATER AND MECHANICVILLE STREET RAILWAY COMPANY, have applied to the Secretary of State, for permission to change the motive power of the road from horses to electricity. Work will be commenced as soon as the required permission is granted. The stock and franchise of the road is owned principally by the banking house of D. Powers & Sons, Lansingburgh, under whose management a new company will be formed to construct and operate the electric road. The plans are under way, and it is stated that they include a belt line track over a number of Mechanicville streets, as well as an ultimate extension to Waterford, and possibly a connection at that point with the Troy City Railroad, although the latter plan is at present a very remote contingency.

ELECTRIC CARS FOR SWIFT MAIL TRANSFER.

DISCUSSING the question of mail transfer in large cities, so as to gain time, Postmaster-General Wanamaker says in his forthcoming annual report:—"The great needs of New York, as I have repeatedly pointed out, are a new Post Office building and a pneumatic tube or electrical service. The citizens of the metropolis may have these absolutely necessary facilities whenever Congress votes the money for them, and the pneumatic tube experiment already in progress in Philadelphia will show results, I hope, which will render it safe for Congress to apply the system generally to large cities, for there can be no adequate postal service in such immense and growing population centres as New York, Chicago, and Philadelphia, and perhaps in places like St. Louis and Boston also, until the tubular or electric post is made use of. I have never tired of pressing this need, and if Congress should not meet it I hope the great cities will continue the agitation. However much the Postmaster-General is called to account, he cannot give these facilities until Congress says so and makes appropriations."

BIDWELL ELECTRIC RAILWAY LITIGATION.

A DISPATCH from Toledo, O., of Dec. 3, says:

"Suits were brought here to-day involving every electric street railway in the United States. Two suits were filed in the United States Circuit Court by the Hon. Frank H. Hurd and O. S. Brumback, attorneys representing Benson Bidwell of Rochester, Ind., against the Toledo Consolidated Street Railway. It is claimed that this company has infringed Bidwell's fundamental original patents for running electric cars and the principle involved in the use of underside spring contact; also, that the patents for the running and lighting of cars with the same current of electricity and the lighting of streets and houses along the line from the current which propels the cars have been infringed upon.

Charles F. Bidwell of this city is interested in the patents of his father, Benson Bidwell, and has been working for the past three years with a view to bringing suit against the street railway companies which, he claims, have been infringing upon them. The Consolidated is to be a test suit.

Mr. Charles Bidwell claims that the prospect for winning the suit is good, inasmuch as the attorneys, Messrs. Hurd & Brumback, have been investigating their claims for over two years, and have now decided to commence the fight.

The two suits filed, one for the lighting, the other for the underside trolley patent, are in the name of Benson Bidwell, Trustee, but back of him is a long list of parties interested, including C. F. Bidwell of Rochester, Ind., Charles F. Bidwell of Toledo, the Hon. Frank H. Hurd of Toledo, O. S. Brumback and Jennie C. Brumback of Toledo, the Fidelity Safe Deposit and Trust Company of Philadelphia, executors of the William Howells estate, William Rosengarten of Philadelphia, and others."

Some of our readers may remember the Bidwell electric railway exhibit about 100 feet of track, with one car, made at the Philadelphia Electrical Exhibition in 1884. Mr. Benson Bidwell was in charge of the exhibit, which was in the annex.

NEW ORLEANS, LA.—The deal by which the New Orleans City & Lake and the Crescent City Street Railways pass into the hands of Northern parties has been effected. The new owners will organize with Jesse Seligman, of New York city, as president, and Maurice J. Hart, of New Orleans, general manager. It is intended to equip all the lines with electricity.

MT. VERNON, N. Y.—The common council of this city, has set aside the veto of Mayor Brush and conferred upon the Westchester Electric Railway the right to begin the erection of its line through the city, over a route previously designated.

MISCELLANEOUS.

THE EWING MAGNETIC CURVE-TRACER.[1]

AT a meeting of the Cavendish Physical Society, Cambridge, Prof. Ewing gave an exhibition of his magnetic curve-tracer, using a form of the instrument which has just been constructed by Messrs. Nalder Bros., of London, with the object of allowing the magnetic cycle to be performed at a high speed. The instrument is shown in Fig. 1, which is engraved from a photograph. The magnetic circuit, whose variations of magnetism are exhibited, is arranged as a rectangle standing up from the base plate, and supported by a post in the centre. It is laminated, consisting of a number of strips of thin sheet iron, of the kind used in transformer cores. The ends of these are securely clamped in a pair of wrought-iron pole-pieces on the base plate, which is a slab of slate, and the poles have a narrow gap between them within which the stretched wire works which gives vertical motion to the mirror, proportional to the varying magnetism of the laminated circuit. A gun-metal casting, arranged in the form of a bridge, supports the compound lever by which the pivot of the mirror is supported, as well as the springs which serve to keep the connecting threads taut; and the same bridge piece forms a post for the support of the main magnet, and also carries the other electromagnet, which consists of a piece of iron tube split longitudinally to form a slot for a second stretched wire, which gives horizontal deflection to the mirror proportional to the magnetizing force. This result is secured by keeping the magnetization of the tubular magnet constant, and by allowing the current which circulates in the magnetizing coil of the main magnetic circuit to pass through the wire that is stretched in the slot of the tubular magnet. The pivot-point of the mirror is held by a system of two adjusting levers which are moved by milled-headed screws to give it two adjustments, vertical and horizontal, for the purpose of bringing the zero position of the spot of light to any desired point of the screen. The mirror itself is pivoted in the manner shown in Fig. 3. The mirror *a* is cemented to a little cradle *b* of aluminium, in which a small hole or rather recess, is drilled just behind the mirror. Into this recess a needle point, held by the fixed piece *c*, enters. At the other side of the cradle two threads are attached, of which one, *d*, goes down to the vertically-moving wire in the gap of the variable magnetic circuit, and the other comes out, perpendicular to the plane of the paper, to the horizontally moving wire in the gap of the constant magnetic circuit. A pair of light spiral springs, of which one is indicated in the sketch at *e*, hold the threads taut and are set to rake back a little, so that they give a component of force pressing the mirror cradle against its pivot sufficiently to prevent it from slipping off.

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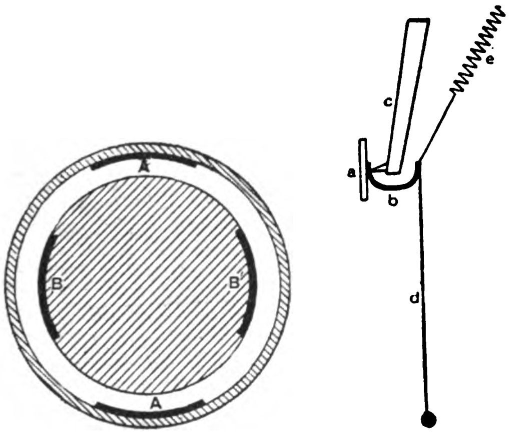
[1] London *Electrician*.



FIGS. 2 AND 3.

The magnetic cycle is performed in one-tenth of a second or less, but so smoothly that the mirror is at no stage subjected to any jerk. This requires that the variations of magnetizing current shall be continuous and gradual. An ordinary commutator with sudden makes and breaks of contact will not do, and the necessary smoothness is obtained by using a continuous commutator, the joint invention of Prof. Ewing and Mr. C. G. Lamb, which was described at the Cavendish Physical Society for the first time. The principle of the continuous commutator will be seen by reference to Fig. 2, which gives a sectional plan of the essential parts of the instrument. A cylindrical vessel of glass or earthenware, containing a solution of sulphate of zinc, has two zinc plates, A and A', fixed in it at diametrically opposite portions of the inner circumference. These plates are connected respectively to the two poles of a battery. A boss of non-conducting material nearly fills the vessel, leaving only a narrow clearance space round it for the sulphate solution. The boss is supported on a footstep; which allows it freedom to revolve, and is turned either by hand or by a pulley at the top connected with an electric motor. A second pair of zinc plates, B and B', are fixed to the boss itself, on opposite sides of its circumference. As the boss revolves the plates fixed on it take a potential difference approximating to that of the fixed plates, as they pass these; then a quarter revolution brings the potential difference gradually to zero, the next quarter revolution raises it gradually to a value equal and opposite to the first, and so on. The plates carried by the boss are connected to collecting rings on the vertical spindle, from which currents are led off through brushes to the magnetizing coil of the magnetic curve-tracer. By having one of these continuous commutators placed in series with a fluid resistance slide, to superpose a continuous reduction of the strength of the current on periodic changes on its sign, the experiment was shown of "demagnetizing by reversals," in which the curve-tracer exhibited the cyclic process, gradually diminishing its range until the area of the diagram vanished. The "Rayleigh" stage of the magnetization, when a feeble force applied or reversed gives magnetic changes involving no hysteresis, was well shown in this way. A still more striking experiment consisted in placing two of the continuous fluid commutators in series, and turning one slowly or quickly by hand, while the other was left revolving uniformly at a high speed, when small loops appeared superposed on the principal cycle of magnetization.

The main magnet of the instrument, shown in Fig. 1, is wound with two magnetizing coils, which allow experiments to be readily made showing the influence exerted by a permanent magnetization of any assigned value on the behavior of the metal with respect to a supplementary force subject to cyclic variation, and on the amount of hysteresis which such a supplementary cycle involves.

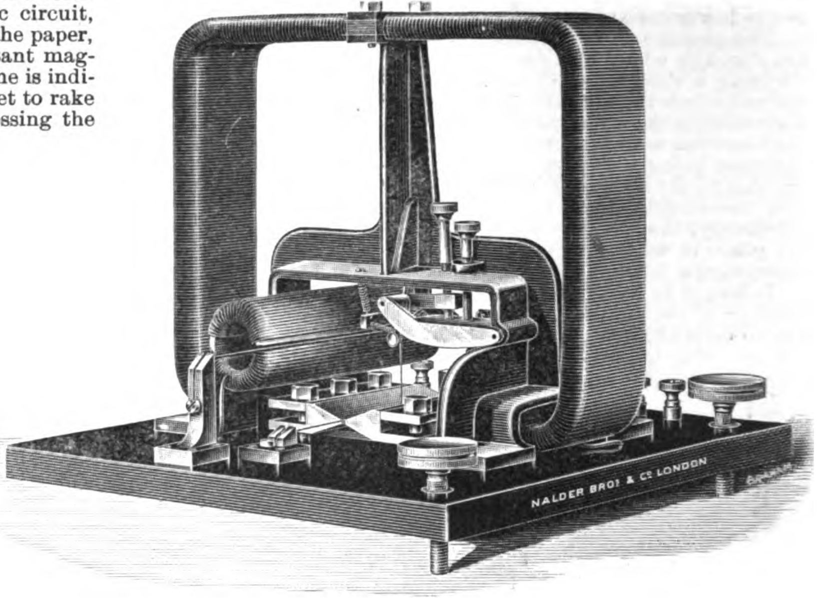


FIG. 1.—EWING'S MAGNETIC CURVE TRACER.

LEONARD'S SYSTEM OF CONTROL FOR ELECTRIC TRAVELING CRANES.

THE Leonard system of control for electric motors differs essentially from other methods by virtue of the fact that the regulation is effected in the electric generator supplying the motor and not in the motor itself. In methods heretofore used the generators produced a constant pressure and were not regulated when a change of speed or of direction of rotation of the motor was desired; but all the regulation was effected at the motor by reversing switches and rheostats in the path of the current supplied to the motor.

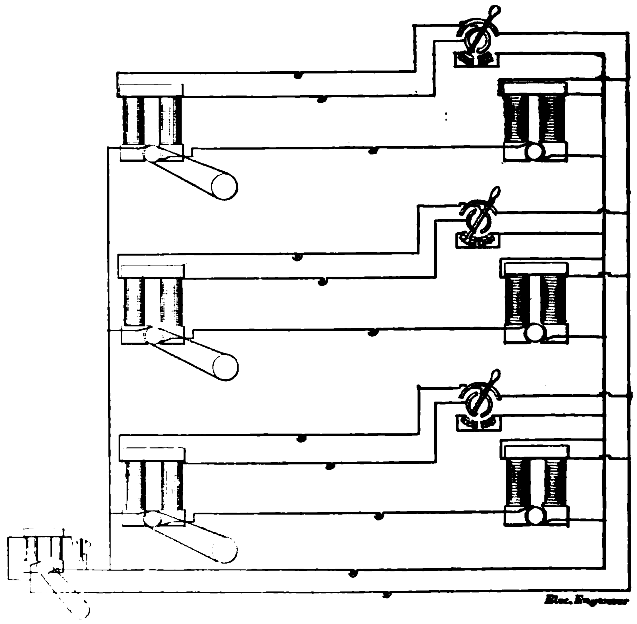


FIG. 1.—THREE MOTOR CRANE, EACH MOTOR CONTROLLED INDEPENDENTLY.

In the Leonard system, when it is desired to reverse the direction of the motor, the magnetism, and, consequently, the current of the generator, is reversed. Similarly, when a lower pressure is desired on the motor, in order to go slower, the pressure produced by the generator is reduced, instead of keeping the pressure of the generator at its full amount and reducing the pressure supplied to the motor by means of a rheostat.

To move a load slowly by the rheostat system requires practically the same power as is required to move it rapidly, the surplus energy not desired being dissipated in the rheostat. In the Leonard system the power required is proportional to the work done in all instances, so that, for instance, to move a load at one-quarter speed requires but one-quarter of the power needed for full speed.

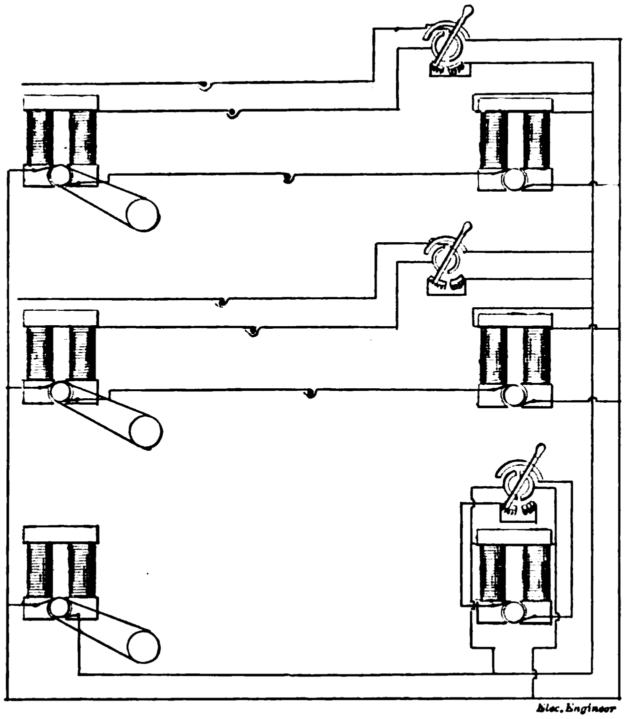


FIG. 2.—THREE-MOTOR CRANE, TWO MOTORS CONTROLLED INDEPENDENTLY.

The control in the Leonard system, it will thus be seen, is effected entirely by varying the strength and direction of the current supplied to the field of the generator. In a well designed generator of moderate size, the current for the field is about 1½ to 2 per cent. of its total output, so that the current varied is extremely small, even in the largest generators, and, consequently, the controller is very small and entirely sparkless.

The accompanying diagrams, Figs. 1 to 4 inclusive, show various modifications of the application of the Leonard system to traveling cranes. No mechanical brake is required in the system, as the retardation of the load is accomplished by causing the motor to become a generator, which feeds back current to the general system, thereby not only bringing the load smoothly and rapidly to rest, but also effecting a marked economy by utilizing energy usually wasted in friction. Both the generator and motor are entirely sparkless under all conditions. This system is applicable to any electric generator and motor made, without any alterations whatever, and has been already applied upon motors of the following makes: Edison, Eddy, C. & C., Elektron, Eickemeyer, Waddell-Entz, Crocker-Wheeler and several others.

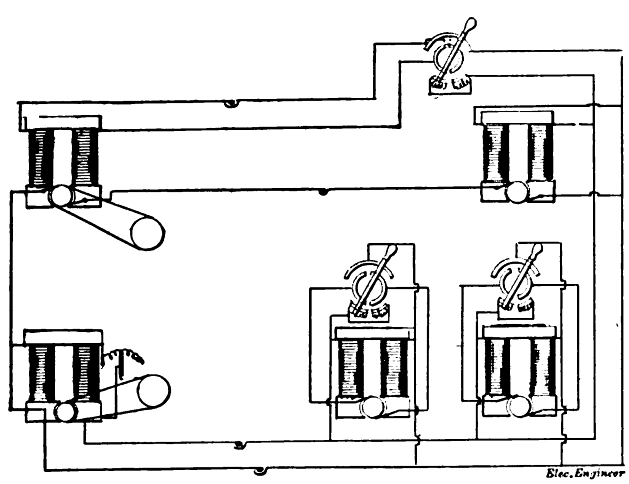


FIG. 3.—THREE MOTOR CRANE, ONE MOTOR CONTROLLED INDEPENDENTLY.

Under the Leonard system the speed of the motor is practically independent of the load. In other words, there is at command an infinite number of automatic speeds in either direction of rotation. It is very surprising to see a motor turning but a few revolutions per minute under only frictional load, and then pick up its full load without slowing down appreciably. Similarly, when running slowly under full load, its speed is not appreciably affected if the entire load be removed instantly. When the motor is running under full load, at full speed, the reversing lever can be thrown over instantly and the load will be quickly and smoothly retarded and then accelerated to full speed in the opposite direction, without the least jar or any sparking whatever.

The system of control is thoroughly protected by patents in this country and abroad. It is of interest to know that licenses have been granted to quite a number of leading manufacturs of hoisting machinery, among them the following: William Sellers & Company, Incorporated, Philadelphia; T. Shriver & Company, New York City; Otis Brothers & Company, New York City; Crane Brothers, Chicago; Hale Elevator Company, Chicago; Whittier Machine Company, Boston; Stokes & Parrish, Philadelphia. Wherever a motor is desired to operate at varying speeds under varying loads, and especially where it is also to be reversed in direction, this system gives excellent results. The perfection of the control in all movements of the load by this system make it of great value in traveling crane practice.

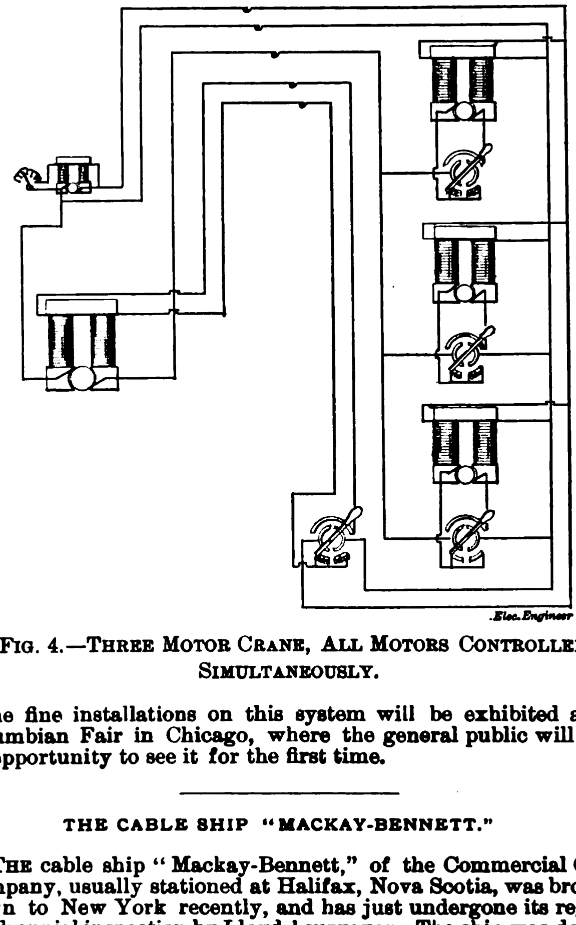


FIG. 4.—THREE MOTOR CRANE, ALL MOTORS CONTROLLED SIMULTANEOUSLY.

Some fine installations on this system will be exhibited at the Columbian Fair in Chicago, where the general public will have an opportunity to see it for the first time.

THE CABLE SHIP "MACKAY-BENNETT."

THE cable ship "Mackay-Bennett," of the Commercial Cable Company, usually stationed at Halifax, Nova Scotia, was brought down to New York recently, and has just undergone its regular quadrennial inspection by Lloyds' surveyor. The ship was docked at the Erie basin, South Brooklyn. At the invitation of the company we were afforded the pleasure of a visit to the ship, under the guidance of Capt. Schenk, its courteous and able commander. The ship is in every way a model one, being equipped with double screw propellers, which fit it specially for the duties for which it is designed, the ship being able to turn on its heel, a great advantage in cable laying and repairing operations.

The deck arrangements for handling and testing cable work are of the most approved type, and the comfort of the officers of the vessel has been amply provided for.

As to the excellent equipment of the ship and the high order of discipline maintained by Capt. Schenk, no better testimony is needed than the report made by the Lloyds surveyor, to the New York Board of Fire Underwriters, which contains the following: "On examining this ship even down to her ballast tank, I have never in all my experience found a vessel in more perfect condition. The discipline prevailing on board is first class, and the Commercial Cable Company is to be congratulated on the possession of such a fine vessel with so able a commander." We can add nothing to this.

ON THE DISSIPATION OF THE ELECTRICAL ENERGY OF THE HERTZ RESONATOR.[1]

BY V. BJERKNES.

In introducing conducting wires of different metals into his resonator Hertz asserted that neither the resistance nor the magnetic properties of the metal involved a sensible change in the length of the secondary spark.[2] We should, therefore, be tempted to conclude that the oscillations are completely independent of the nature of the metal. This independence is, however, only apparent. In my researches I employed a circular resonator having a diameter of 0.40m., and a complete period (double) of 14 x 10^{-8} second. The poles took the shape of vertical parallel discs 0.008m. apart, and 0.08m. in diameter. In the field constituted by the gap between these dics a piece of aluminum foil, forming an angle of 45 degrees with the azimuth of the discs, was suspended by a quartz thread as an electrometer needle. Instead of the secondary spark the deflection of this needle was observed.

In this resonator I employed in succession geometrically identical conducting wires of different metals, and I obtained very different deflections. In the diagram Fig. 1, I give the results obtained with six wires, all of 0.5mm. diameter, but made of copper (Cu), brass (L), nickel (Ni), iron (Fe), German silver (M), and platinum (Pt) respectively. The resistances of the wires are marked as abscissæ, and the ordinates show the deflections of the electrometer needle.

The results given in this figure appear at first glance singularly opposed to those obtained by Hertz. I think, however, that this divergence is only due to the difference of the methods. The oscillations of the resonator commence at zero and rapidly tend to a maximum, and gradually decrease afterwards. By the spark we evidently measure the height of this maximum; by the electrometer we measure the sum of all the oscillations.

Owing to damping, this sum may have very different values without materially altering the height of the maximum. Consequently, the observations of Hertz show that the resonator always receives the same amount of electrical energy; the electromagnetic measurements show that this energy is dissipated more or less quickly, according to the nature of the metal.

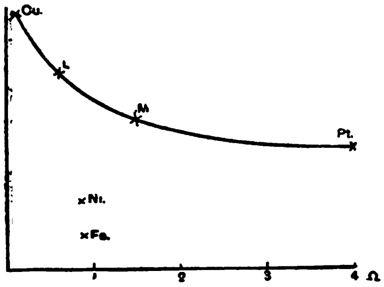


FIG. 1.

The capital point is thus the dissipation. The laws which govern it are represented indirectly by the diagram; a small ordinate corresponding to a rapid dissipation. It will be seen that the four non-magnetic metals ranged themselves on a curve having uniformly decreasing ordinates. On the other hand, the two magnetic metals, that is to say iron and nickel, are quite outside the curve, and the most magnetic metal is that which is the furthest from the curve. I have, therefore, come to the following conclusion: – *The rapidity with which the electrical energy of the resonator is dissipated is increased by the resistance and the magnetism of the conducting wire.* This dissipation may take place in two different ways, by radiation across the dielectric medium, or by transformation into heat in the conducting wire. The considerable influence possessed by the physical constants of the metals seems to indicate that the transformation into heat is the principal cause. This transformation takes place in the thin superficial layer along which the electric currents flow. I endeavored to determine the thickness of this layer with a view of getting to the bottom of the question.

To ascertain this, I covered the iron wire with thicker and thicker electrolytic layers of copper, and I found that the deflections of the electrometer increased, approaching asymptotically to the value of the deflections which took place in the case of the solid copper wire; the difference between the wires disappeared when the layer had a thickness of 0.01mm. I next covered the copper wire with electrolytic layers of iron; even a layer 0.0002mm. thick had an appreciable effect. The deflections very quickly approached the value which they had in the case of the solid iron wire, and all difference disappeared at the moment when the layer exceeded 0.003mm. in thickness. *I conclude, therefore that the currents penetrate less deeply into the magnetic metals than into the non-magnetic metals.*

This result explains the part played by magnetism in the dissipation of electrical energy. The currents being confined to a thin layer, these would encounter a greater resistance, and consequently there would be a greater generation of heat. This explanation agrees with the theory already put forward by Lord Rayleigh and Herr Stefan. I may remark in conclusion that the penetration of alternating currents into the metals is a phenomenon of the same nature as the penetration of light into them. The results which I have obtained are sufficient to prove that metals are more transparent to luminous undulations, which agrees perfectly with theory.

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[1] From the *Comptes Rendus*, Vol. CXV., No. 19.

[2] Hertz *Ausbreitung der Elektrischen Kraft*, p. 50.

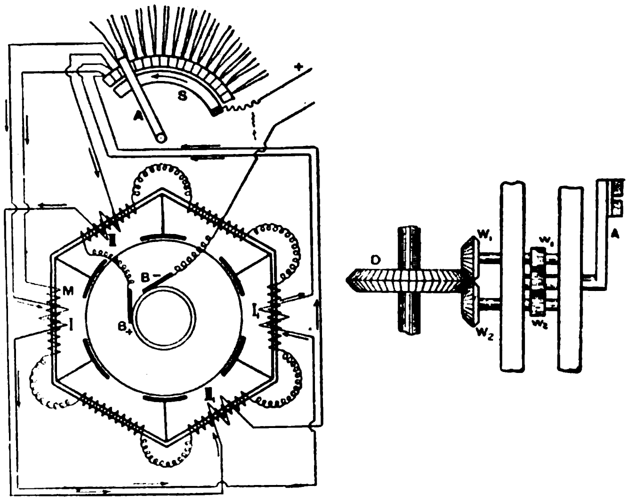
THE GENOA CONTINUOUS CURRENT TRANSFORMER.[1]

Mention has already been made in these columns of the 6,000 volt continuous current transmission plant installed by MM. Cuenod Sautter, of Geneva, for the purpose of supplying power to the dynamos of the Société Genoise d'Electricité, and to other concerns. The following additional details are of interest:

Power is derived from the Ferrari-Galliera aqueduct at a point some 16 miles from Genoa. Three turbines each drive two separately excited Thury 1,000 volt 45-ampere dynamos; the speed of the turbines and the current of the machines being automatically kept constant. The line, which is of bare wire, is carried on oil insulators, and runs underground on entering the town.

At Genoa the current is fed into three Thury motors belted to a countershaft from which four low pressure machines are run. These dynamos supply current to a three-wire 230 volt system. As the two-pressure machines are of the ordinary constant potential constant-speed type, the constant-current motors have to be kept running at a rigorously constant speed whatever the load, and this is effected by an automatic regulator acting on the field excitation of the motors.

The main excitation of the motors is supplied by a large number of series coils in the usual way. The additional excitation required as the motor load is increased is furnished by pairs of coils arranged on diametrically opposite pole-pieces. The + and — ends of these coils are connected to a regulating switch S, as shown in Fig. 1, the main exciting coil being taken to the left-hand segment. The current from the line comes to the strip S, passes across the revolving arm A to the additional excitation coil I, thence to I_1, back to the switch, thence through the additional coils II and II_1, again back to the switch, and thence through the main coils M to the brush B +, through the armature to line by the brush B —. The revolving arm A is rotated by the motions of a centrifugal governor. A toothed disc D, Fig. 2, formed by the juxtaposition of two truncated cones, is placed on the same shaft as the governor balls. Above and below this disc are two mitre wheels, W_1 and W_2, having on their axes the pinions w_1 and w_2, gearing with a toothed wheel, which transmits its motion by an endless screw (not shown) to the revolving arm A. When the speed is normal the disc D is in contact neither with W_1 nor with W_2; but as soon as it increases above or falls below the normal, the disc engages with one or the other of the mitre wheels, and the arm A is suitably rotated.



FIGS. 1 AND 2.

By its arrangement with the Société de l'Aqueduc Ferrari-Galliera, the Société Génoise d'Électricité has to pay a fixed charge

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L' *Electricien.*

of 300 francs per horse power per year demanded, so that it is obviously to the advantage of the electric light company both to keep down the maximum amount it has to demand and to make the maximum use of the amount actually demanded. Secondary batteries are, therefore, made considerable use of in Genoa, and in order that the dynamos may be able to supply the mains at the same time as they are charging the cells, the battery voltage of 310 to 320 volts is kept down to the proper amount by a compensating dynamo placed in series, its field being regulated as required. The ordinary regulation of the voltage of the cells is carried out automatically by means of electromagnetic devices for switching cells in and out.

LETTERS TO THE EDITOR.

EFFICIENCY OF ALTERNATING PLANTS.

I DO not profess to be an electrical engineer. I am only an ordinary engineer; that is to say, I think I understand how to set up and run a stationary steam engine and boiler, and to get pretty fair work out of it; I have learned enough of electrical matters to be able to manage an incandescent lighting system without any serious breakdowns, and apparently to the satisfaction of the consumers. I regret to say, however, that the owners of the plant are not nearly so well satisfied as the consumers, and hence arises a predicament from which I appeal to you for the means of extrication.

When I took charge of this plant, the outfit consisted of one 750-light alternating dynamo and exciter, one horizontal steam engine rated at 75 h. p., one pair of mains half a mile or so in length, and some 600 lamps wired on about 50 transformers. The parties who installed the plant stated, although they did not apparently guarantee, that every 20 lamps of 16 c. p. each, when lighted, would take one ampere of current on the station ammeter, at a pressure of 1,100 volts. When I took charge, I found that the plant was not doing nearly so well as this, but being unable to discover any serious defect, and being also somewhat distrustful of my own knowledge, I advised having an expert sent for to look things over. He came; he had the coal weighed, superintended the firing, calibrated the ammeter and voltmeter, examined this and that, and finally, with a look of incomparable wisdom, announced that the plant was underloaded, and that when the full complement of lamps were connected with the machine, the discrepancies which I had observed between the consumption of coal, the indications of the station instruments, and the results of the house meter readings would probably disappear. I regret to say that experience has shown that they do nothing of the kind.

According to the original assumption, when the dynamo is carrying its maximum load of 750 lamps, we ought to be consuming about 75 h. p. and sending out 80 amperes of current in the primary wires, while at the rate charged (1 cent per lamp hour), the station should then be earning $7.50 per hour, or at the rate of 20 cents per ampere hour.

We have now two pairs of mains, one carrying 1,145 lamps and the other 154 lamps. These are wired on 97 transformers. This month we are running 8 hours per night, and the following extract from the station log-book will show the character and amount of work we are doing. The figures are amperes at 1,100 volts.

	Sunday.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.
4.30 p. m........	17	22	21	22	20	23	18
5.30 "	23	30	30	31	30	34	29
6.30 "	23	34	34	33	33	35	34
7.30 "	22	35	35	35	36	38	36
8.30 "	22	35	34	36	32	31	32
9.30 "	19	25	24	24	28	24	27
10.30 "	16	18	21	20	21	22	22
11.30 "	12	15	16	15	18	17	16
Total ampere hours	154	214	215	216	218	224	214
Coal consumed....	1,500	1,800	1,750	1,800	1,800	1,850	1,750

Total ampere hours for 1 week, 1,455.
" " 31 days, 6,022.
Total coal (bituminous) consumed in 31 days...21.75 tons.

Theoretical revenue for 31 days ...6,022 x .20 =	$1,204.90
Actual revenue as per house metres...........	725.60
Deficit................	$479.30

Thus it will be seen that although the plant, as heavily loaded as it ought to be (the maximum current being nearly 40 amperes at times, which warms the dynamo considerably), we appear to be getting paid only for something like 60 per cent. of the current we are sending out. Now, where am I to look for the loss? The insulation of the plant is apparently good, the wire is nearly all "Simplex," and none of the wiring is of less gauge than called for by the accepted formulas; most of it, indeed, is larger. Can so large a loss as this be due to inefficiency in the transformers? The owners of the plant think I ought to make it do better. I think so, too; but I should like to hear the experience of some of the other central station men, who are running plants of similar capacity. One electrical engineer of much experience informs me that if I get as much as 17 lamps per ampere I am doing very well, but I cannot do even as well as that. Of course, I know that the work ought to be done with less coal than is being used, but I understand well enough where the trouble is in that particular. I would like a little more light on the electrical branch of the problem.

W. H. C.

NOV. 25, 1892.

THE SPRAGUE-PRATT ELECTRIC ELEVATOR.

MR. SPRAGUE'S answer to my suggestion regarding the Sprague-Pratt electric elevator, which appears in your issue of Nov. 30th, to the effect that "with any well constructed machine, free from internal friction, where the duty required of the motor is measured by the work at the hoisting ropes, the motor cannot be stalled," indicates that Mr. Sprague's experience with electric elevators has been more limited than my experience with electric motors. I think I may be credited with having assumed his machine to be well constructed and that he will use a motor which will be of sufficient horse power to perform the required duty. All elevator builders, like builders of other apparatus, claim that their machinery is well constructed, and it is absurd to suppose that a 10 h. p. motor would be installed where 15 h. p. is required. The point I make is that in the Sprague-Pratt elevator there is no protection for the motor in case, for instance, the brake does not release promptly, or a safe weighing more than the motor can lift is placed in the car. These are occurrences which are very likely to happen and which cannot be figured upon when measuring "the work at the hoisting ropes." Certainly they are as likely to happen as the tricks of the "vicious boy," and should be as fully guarded against. The fact that a number of devices for protecting the armature from injury due to the same and similar occurrences have been patented by various manufacturers, all of whom claim their machinery to be "well constructed," is evidence of the need of such a thing.

Mr. Sprague suggests that I may be the spokesman for some one else. I fail, however, to see in what way that question affects the discussion, but will state that I am speaking solely for myself, and with the license given by the publication of his article.

WM. A. ROSENBAUM.

NEW YORK CITY, Dec. 5, 1892.

LITERATURE.

Traité de Télégraphie Sousmarine. By E. Wünschendorff. Paris: Baudry & Co. 555 pp. 7½ x 11 inches. Price, $8.

No progressive electrical engineer can afford to be ignorant of what is being done in the way of cable manufacture in the great centres of electrical industry across the Atlantic. Especially to manufacturers of cables is a knowledge of this character more important than to the general electrician, for the only way to insure having the best methods is to observe and study those employed by others working in the same departments and adopt such as appear to produce better results than our own. The present work gives a very comprehensive description of the processes and machinery used in the manufacture of submarine cables in European factories, together with other valuable information relating to cables, and is a volume which deserves a place in every electrical and scientific library. As the manufacture of the best submarine cables involves the use of what are known as trade secrets, the reader must not expect to find such secrets disclosed in this work; but, excepting that knowledge of the subject which can be acquired only by years of experience in cable factories, he will be well repaid by reading the book and the information he will obtain will give him a very correct idea of submarine cable manufacture.

The author has treated his subject under five general divisions, the first being historical and giving a brief account and description of the principal deep sea cables, with charts showing their location. The second part describes the manufacture of cables, detailing the composition and properties of their different parts and the machinery used in making them. The principal materials used for dielectrics and exterior envelopes are treated of here; also the methods and apparatus used in preparing and applying them. Various mechanical tests of cables and apparatus, for making the same are also described; joints are included in this division. Part III treats of the immersion and repairing of cables. Beginning with the construction and arrangement of ships employed for this purpose, an account is given of the machinery and apparatus used in immersing, grappling, repairing and raising cables, and also that used in sounding and in taking the temperature of the ocean. The use of buoys and descriptions of the same are also treated of. The injuries most likely to occur to cables from anchors, lightning, the teredo, etc., are described, and remedies therefor suggested. In Part IV the various processes of testing cables, locating faults, etc., are given, with the instruments necessary for conducting such tests. Part V is devoted to exploitation, and explains the transmission of signals and apparatus used in the same. If we have a criticism to make it would be that greater prominence might have been given to the employment of electrical tests during the manufacture of cables, especially those by means of the quadrant electrometer.

The book is well written, contains large clear type, and is thoroughly practical. It contains a great variety of useful formulæ and tables, and excellent illustrations are used whenever necessary to a proper understanding of the subjects treated of.

Thirteenth Convention of the National Electric Light Association. Official Report. *James Kempster Printing Co.* New York, 1892. Cloth. 842 pages.

THIS is the latest volume of transactions issued by the National Electric Light Association, and embodies the proceedings at Providence, R. I., in February, 1891. It is a great pity they have not appeared ere this, as the convention was a most successful one and included a great many features of interest and value. Mr. Marsden J. Perry, then president, did not a little to enhance the importance and dignity of the Association, and left a deep impress for good. Much that is contained in this volume is of permanent interest, and we are glad to know that Mr. Porter, the secretary, is now actively engaged in seeing the transactions of the Montreal and Buffalo conventions through the press. He believes, wisely, that not more than three months should elapse between a convention and the issuance of the official report; and he has done much to bring up the rather regrettable arrears in this respect. The printing and binding of the volume are admirable, and we are delighted to note that the Association has adopted a handsome uniform style for its transactions, in cover, typography, etc. We take this opportunity of earnestly recommending our central station friends to join the Association, if they have not already done so.

With Edison At Schenectady, 1892. A volume of photographs compiled and published by W. H. Butler, Schenectady. 50 sheets containing 125 photos. Cloth $6. Seal leather, gilt edges, $10.

WE have received from Mr. W. H. Butler, of Schenectady, N. Y., a very handsome and artistic volume of photographs, bearing the above title. It is a most interesting collection. There is no explanatory text, and in reality none is needed. The photographs—which run about 9 by 11 inches—have been made from subjects and scenes selected with rare judgment, and grouped with the skill and taste of an artist; and one obtains immediately in turning over these pages a very vivid and faithful idea of the daily work at the great Edison Schenectady Works, with their immense variety of electrical product. Not only is the apparatus clearly brought before us in an interesting manner, but the processes are shown in minute detail. The book is of great value if only as indicating methods in vogue at the present time, in one of the largest American electrical factories. To those who have had any connection with the Edison industries the book must have a special attraction and merit, the more because it contains the portraits of Mr. Edison and a number of his lieutenants. The mounting of the photographs, and the binding, are excellent. A copy of the book can be seen in the reception room of THE ELECTRICAL ENGINEER.

Electric Toy Making for Amateurs. By T. O'Connor Sloan. *Illustrated.* New York, *Norman W. Henley & Co.* 138 pages, 5 x 7 inches. Price, $1.00.

Experience has shown that more than one "amateur," as the expression is commonly used, has made valuable contributions to science, and that the line heretofore so sharply drawn between the scientific amateur and the scientist must now be broadened. Indeed, Prof. Schuster in his recent inaugural address before the British Association, went so far even as to designate Faraday as a scientific amateur in electricity, considering the fact that he took up the subject outside of his profession as a chemist. Making simple apparatus or electric toys is one of the surest ways of interesting beginners in any science and of developing amateurs. This is pre-eminently the case in the domain of electricity, and the little work before us will afford ample opportunity for practice. The apparatus covers considerable range in the application of fundamental principles and will serve an excellent purpose in inculcating these in a manner which no amount of book knowledge can replace. The illustrations are very clear and the text is lucid.

Simple Lessons in Drawing, for the Shop. By Orville H. Reynolds. *Debs Publishing Co.* Terre Haute, Indiana, 1892. 88 pp., 4 x 6½ inches.

This little work is well calculated to give the beginner correct ideas as to the manner of putting on paper designs and plans of machinery. The practical shop methods are always kept in mind and clearness is aimed at above everything. The little work ought to be in the hands of every mechanic and inventor.

LEGAL NOTES.

THE EDISON-SAWYER-MAN LAMP CASE—I.

EDISON ELECTRIC LIGHT COMPANY AND EDISON GENERAL ELECTRIC COMPANY *vs* SAWYER-MAN ELECTRIC COMPANY. FINAL HEARING BEFORE THE UNITED STATES CIRCUIT COURT OF APPEALS.

THIS important case came up for argument in the United States Circuit Court of Appeals, before Judges Wallace, Lacombe and Shipman, Dec. 6, on appeal, as agreed by counsel on both sides in Circuit Court, before Judge Lacombe, Nov. 19.

Messrs. Clarence A. Seward, Grosvenor P. Lowrey, Frederick P. Fish and Richard N. Dyer appeared for the complainant, and Messrs. Edmund Wetmore, Elihu Root and Leonard E. Curtis for the defendant.

The appeal was taken by defendant from the order of the Circuit Court granting a preliminary injunction. The injunction, it will be remembered, was issued and then stayed by counsel on both sides pending the appeal. The suit has been pending for a number of years and was revived, under its present title, soon after the decision of the Appellate Court sustaining the Edison Incandescent Lamp Decision.

Before argument was begun MR. H. W. CHAPLIN arose and made application to be heard in behalf of the Mather Electric Company and in behalf of Mr. Allen, United States Attorney for the District of Massachusetts, stating that suits were pending in the United States Circuit Court for Massachusetts by both parties named seeking relief by way of a general and permanent injunction against what is alleged in their petitions to be an illegal combination, under the common law and under the so-called Sherman act and that in one of these actions one of the plaintiffs in the present suit is alleged to be a party. At the threshold of these Massachusetts suits, and at that of the present suit, thought Mr. Chaplin, lay questions as to the existence and legality of a combination which appeared of record in this case. There was on file with the case a notice from the plaintiff in the Mather suit, and a petition by Mr. Frank D. Allen, United States Attorney for Massachusetts, requesting this court to allow counsel to be heard as *amicus curiae* upon the questions which underlie the several suits—which go to the character, legality and existence of a trust. The desire of the petitioners was that they should not practically have their right adjudicated upon in the present case without being heard.

MR. ROOT for the defendant did not wish to show any discourtesy to the United States Attorney from Massachusetts, or to his representative, but as his application sought to support one of the positions which had been taken by the defendant in the assignments of error, he, Mr. Root, wished to say that the request was entirely without concert or assistance on the part of his clients. They were entirely indifferent as to whether the United States Attorney for the District of Massachusetts, or any one else, should act as the *amicus curiae*.

MR. LOWREY, for the complainant, said that they were, of course, exceedingly glad to see any friend of the Court at any time, and they were also glad their friends upon the other side did not intend to be discourteous. Their own notion, however, after reading the petitions, was that they did not exactly know what he was there for; but they suspected that he was an infringer from down East. "At any rate," said Mr. Lowrey, "we have no objection to his being here; and particularly in this great Democratic city we feel that we owe a certain hospitality and welcome to the State that has recently elected my friend Governor Russell; and upon that ground, if no other, we think the gentleman ought to be heard." After some further remarks by counsel and Mr. Chaplin, the Court granted that gentleman permission to file a brief if it should be ready by the close of the case. The argument of the case then proceeded.

MR. CURTIS for the Sawyer-Man Company, went over the history of the case in the lower courts to some extent, and explained the relations of the parties to the suit in its present aspect, particularly the position of the Sawyer-Man Electric Company, as the lamp manufacturing department of the Westinghouse Company, and as the source of supply for the large number of lighting plants operated by dynamos and other machinery supplied by the Westinghouse Company. In common with other counsel, heard later, Mr. Curtis traversed much of the ground gone over in the arguments before the lower courts, as well as in the United States case.

The bill in this case had been filed Oct. 27th, 1892, and on the 29th of Oct. the complainant served notice of preliminary injunction, an injunction which would at once affect the supply of lamps to Westinghouse plants throughout the country aggregating 1,300,000 lights.

The defense in the case, said Mr. Curtis, rested upon three general facts: (1.) The great destruction of capital which would result from granting and enforcing an injunction; (2.) A combination which had been formed by all (or substantially all) of the competitors of the Westinghouse Company under the name of the General Electric Company—and which combination had come into existence since the decision of the court below in the United States case—and the purpose which had been developed on the part of the complainant to refuse absolutely to sell any lamps for the supply of plants which use Westinghouse apparatus or for the supply of plants of anybody outside of the combination. These defenses were entirely independent of any questions as to the validity of the patent or infringement. (Court adjourned for the day).

The hearing was renewed on Wednesday, December 7th, at 10.30 a. m.

Mr. Curtis, continuing his argument, directed attention to the assignments of errors, summarized in the defendant's (appellant's) brief under general points. Briefly they were as follows:

First. "The growth of vested interests of great magnitude as the direct result of gross laches on the part of the complainants and their predecessors in asserting their rights under the patent; the irreparable injury that would result to such vested interests, to the large number of workmen dependent on them and to the public, would be inequitable, especially in view of the complainant's laches."

Second. "The injunction should have been refused because the General Electric Company, the real party in interest, intends to make an inequitable use of it."

Third. "No injunction ought to be granted in this case, because it asked and would operate in aid of an inequitable and illegal combination in restraint of trade tending towards unlawful monopoly contrary to public policy."

Fourth. "The relations of the parties to the suit were such that the complainants are equitably estopped from seeking to enjoin the defendant from making incandescent lamps of the character it is now making."

Fifth. "The injunction should be refused because it is sought in aid of an attempt on the part of the General Electric Company, the real party in interest, to take an inequitable advantage of the contract relations established between one of its constituents, the Thomson-Houston Company, and the defendant and its associates prior to the combination by which the said General Electric Company, was formed."

Sixth. "The injunction, if granted at all, should have been conditioned upon the complainant's agreeing to supply lamps to the defendant or to his customers on reasonable terms."

Seventh. "The injunction should have been stayed until the first of January, in order to enable the defendant's associates and customers to procure lamps not covered by the patent."

Eighth. "The defendant, should, in any event, have been permitted to dispose of the stock of lamps on hand under proper conditions as to accounting and security."

Ninth. "The injunction as granted is too broad, and should, in any event, have been limited to the second claim of the patent."

Mr. Curtis would leave argument upon the third, fourth and fifth points to Mr. Root, who would follow, and would confine himself mainly to the remainder. He elaborated and emphasized the arguments already familiar in the United States case upon the first point. Passing to the second point, Mr. Curtis took it up in connection with the sixth, as they were merely different phases of the same subject. He would restate it as follows: "The injunction should have been refused, because the General Electric Company, the real party in interest, intends to make an unconscionable and inequitable use of it; or such conditions should have been imposed as would prevent any such inequitable and unconscionable use of the injunction." As to the use the complainants, or the General Electric Company, proposed to make of this injunction: In the first place, the complainants, under the direction of the General Electric Company, proposed to refuse to sell lamps, if they get this injunction, for use with any machines except those made by the manufacturers included in their combination. This has been, in a certain way, disputed. He would refer, in the record, to the affidavit of Mr. Westinghouse, stating that he had been led to believe, by the reports from agents and customers of the Westinghouse Company, that the General Electric Company intended to make use of the recent decision of the Court of Appeals in such a way as to obtain, through its control of the Edison lamp patent, a monopoly of all the apparatus used for incandescent lighting (of which the incandescent lamps themselves form but a very small part) by enjoining other manufacturers of incandescent lamps and refusing to sell its lamps except for use with generating plants of its own manufacture; and referred particularly to the specific instance coming under Mr. Westinghouse's own observation in negotiations for the World's Fair lighting contract; during which it appeared that one of the complainants in this suit, and the representatives of the complainants, stated that they would not furnish any lamps for use with the Westinghouse apparatus if the World's Fair chose to award the contract to the Westinghouse Company, and that under the injunction, which they expected to obtain, the Westinghouse Company could not make any lamps for itself. He also referred to Mr. Bannister's affidavit, substantially to the same purport as that of Mr. Westinghouse, and to other affidavits of similar tenor.

The Court (Shipman, J.): Have you got any action, do you know of any action by the executive officers or directors of the complainants in this suit in regard to non-sale?

Mr. Curtis: We do not know, your Honor, directly, except so far as this evidence indicates it.

The Court: They are statements by agents in the pursuit of business.

Mr. Curtis, continuing, referred to circulars of the General Electric Company, issued in advance of the Appellate Court's decision on the lamp case, claiming that an injunction would probably be served against every company using lamps other than those of Thomson-Houston and Edison make. The evidence, it was admitted, was not of a very direct character. It was, however, the best that could be got on the subject in the time at the disposal of the defense, and should be taken in connection with the state of feeling among the central station lighting companies which this litigation had caused. Such users and purchasers of lamps were naturally afraid of taking any action with would bring down upon them the special hostility of the General Company. It was difficult to get information from them. Of course, the defendant had not access to the records of the General Company, or of the complainants, to see what action they had taken. The affidavits, however, indicated a general policy foreshadowed as one to be adopted. After further references to the record of the case, and the citation of authorities, showing that the Courts had frequently refused to grant an injunction because of the unconscionable use which the complainant proposed to make of it, Mr. Curtis said: "We recognize the fact that, this patent having been sustained by this Court with an interpretation so broad as practically to cover all forms of incandescent lamps which are available for use to-day—that the Court having found that this patent was substantially the foundation of a new art—the Court will naturally be loath to adopt any course which would deprive Mr. Edison and his assignees of their just rewards for so meritorious an invention. Recognizing that, however, we say that if the protection of these interests which have grown up in this way, can be effected and at the same time a just and adequate reward can be given to Mr. Edison and his company for this invention, the Court ought to adopt such a course as would bring about that result."

Mr. Root followed Mr. Curtis, for the defendant, and directed his argument to the proposition that the case was not really a controversy regarding the use of incandescent lamps, but that in its essence, and at bottom, it was a contention regarding the use of machinery for generating electricity—machinery of very great value—widely used throughout the country, and made by manufacturers who had invested large amounts of money. The complainants had, by their own conduct, introduced such other elements into the controversy than the infringement of electric light patents that the court was bound, in exercising its discretion, to grant an injunction, if granted at all, upon such terms as would be reasonable in limiting its effect. There were two elements in the conduct of the complainant supporting the defendant's contention. First, the laches, of which Mr. Curtis had spoken, in the assertion of their rights while enormous sums of money were being invested, not only in the manufacture of lamps, but in the production of other electrical machinery, under other patents, equally entitled to protection; machinery which it was for the public interest to have manufactured, in pursuit of the industry of electric lighting which it was for the public benefit to have pursued, and while costly plants for the installation of electric lighting were established throughout the country.

Counsel hoped their Honors would not for a moment think he would come into court to seek to sustain the proposition that the Edison Company should not have an injunction for the reason that they had been guilty of some disconnected offences, or had been acting inequitably towards somebody else, or had been doing something they ought not to have done not bearing on the subject matter of this controversy. His proposition was that the Edison Company had entered into an inequitable and illegal combination with other corporations, and that they were seeking the order of this court in aid of that illegal and inequitable combination, and that they were therefore not entitled to an injunction. They stood upon an entirely different footing from that which they would occupy if they were only seeking to secure their own monopoly under their own patent and that only by order of the court.

At the threshold of the question as to the combination, Mr.

Root would say that of course a patent was a monopoly; but it was no more a monopoly than any other kind of property, such as that of the merchant in his goods, or of the land-owner in his real estate, or the manufacturer in his mill and machinery; monopoly was the essence of property. A number of patents—perhaps competing and non-infringing patents—might be brought under a single control for effecting the monopoly of an industry; and such a combination might be just as much a violation of the laws against restraint of trade as a combination or monopoly in respect to any other kind of property. But the nature of property in patents is such that it is much more liable to be made the subject of illegal combinations than ordinary property. Combinations for monopoly of ordinary products, irrespective of patent laws, are always likely to invite the investment of new capital and enterprise in competition; whereas a monopoly sustained by a number of effective patents cannot easily be broken; the monopoly given by the government excluding competition, making monopoly permanent during the life of the patent. Such a monopoly as this, but for the Westinghouse Company and its business, which the court was asked to destroy, had been created by the combination between the various corporations united in the General Electric Company. It appeared clearly in the papers of the case that until recently there had been competing, under separate and different patents, in the manufacture of electrical machinery, quite a large number of companies. Among them the Brush Electric Light Company, the Sprague Electric Railway Company, the Fort Wayne Electric Company, the Van Depoele Electric Company, the Short Electric Railway Company, the Schuyler Electric Light Company, the Excelsior Electric Company, the Thomson-Houston Electric Company, the Edison Electric Light Company, the Westinghouse Electric & Manufacturing Company and others, all named in the defendant's brief.

After recounting the successive consolidations of interest among these companies, culminating in the formation of the General Electric Company, Mr. Root said that the Court would perceive the effect of the union of interests between the Edison General Electric Company (the complainant), and the Thomson-Houston Company. Their Honors would also perceive that each of the companies brought into the combination maintained its separate corporate organization, conducted its own business, owned its own property, and dealt with the public just as it had done before the combination. It was not the case of the acquisition of property by one person, it was not the case of the creation of a monopoly by acquiring the property, it was merely the case of a combination of interests between people who still kept their property, who still kept their title to it, and who still conducted their business separately. The complainant's counsel said regarding the combination, in their brief:

> "The details and particulars of a certain well-known public agreement and transaction are set out as if they constituted a body of forbidden acts. This paper needs only to be read to see that it is not a contract in restraint of trade, etc. In fact, it relates entirely to the method by which shareholders of certain companies, who were injuring each other seriously by competition, conducted their perfectly lawful and most praiseworthy negotiations for a cessation of useless and destructive hospitality."

This is to say, said Mr. Root, this was not a sale, this was not the transfer of title, but it was a combination between these corporations for the purpose of suppressing, preventing and avoiding competition. By means of this combination the General Electric Company controlled the entire production and sale of electric light and power machinery throughout the United States, except the portion produced by the Westinghouse Company and a fraction of about ten per cent. produced by all others. Counsel submitted that such a combination was a violation of the laws both of the United States and of the State of New York. It was a violation both of the statute and of the common law. Their Honors were familiar with the declarations of the policy of the laws which were contained in the Federal Statutes, and Anti-Trust Act. Counsel was not here to urge the Court to punish these people for a criminal violation of the Sherman Trust Act; he was here to say that such a combination was denounced in equity and in law in both the Federal and State jurisdictions, here and everywhere; and if the Court find that they are seeking to make it an instrument in carrying out their combination and furthering its effects, it will be bound to refuse the injunction.

The Sherman Act of July 2, 1890, said:

> Every contract, combination, in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States or with foreign nations, is hereby declared to be illegal.
>
> Every person who shall make any such contract or engage in any such combination or conspiracy, shall be deemed guilty of a misdemeanor.
>
> Every person who shall monopolize or attempt to monopolize a combination, or conspire with any person or persons, to monopolize any part of trade or commerce among the several States, or with foreign nations, shall be deemed guilty of a misdemeanor.

The stock corporation law of New York of 1890, (enforced until May, 1892), provided that:

> No stock corporation shall combine with any other corporation for preventing competition.

In the act passed May 18, 1892, it is provided that:

> No stock corporation shall combine with any other corporation or person for the creation of a monopoly or the unlawful restraint of trade for the prevention of competition in any necessary of life.

This very act, under which the General Electric Company was organized, provided that it should not be considered as "for the creation of a monopoly for the unlawful restraint of trade."

SOCIETY AND CLUB NOTES.

AN IMPORTANT MEETING OF ELECTRICAL INSURANCE MEN.

THE second meeting of electrical insurance inspectors and insurance representatives from all parts of the United States and Canada was held last week in this city on Tuesday and Wednesday, at 156 Broadway. There were 26 delegates present, among whom were: C. M. Goddard, New England Insurance Exchange; E. C. North, New England Insurance Exchange; W. A. Anderson, New York Board of Fire Underwriters; A. E. Van Giesen, New York Board of Fire Underwriters; C. E. Bliven, Western Union; A. E. Braddell, Middle Department; Morton E. Eden, Middle Department; F. E. Cabot, Boston Board; J. P. Freeman, District of Columbia; F. M. Griswold, National Board; W. E. Geyer, National Board; E. A. Fitzgerald, Underwriters' Association of New York State; C. L. Hedge, Underwriters' Association of New York State; J. A. E. Hoeveler, Alleghany County, Pa.; A. W. Hadrill, Canadian Fire Underwriters; A. T. Patterson, Canadian Fire Underwriters; W. McDevitt, Philadelphia Fire Underwriters' Association; W. H. Merrill, Jr., Boston Fire Underwriters' Association; C. F. Low, South Eastern Tariff Association; A. B. Smith, Ontario Fire Underwriters; H. M. Wilson, Cleveland Board.

Mr. C. M. Goddard presided, and Mr. F. E. Cabot acted as secretary. The revised insurance rules already under discussion were taken up, discussed seriatim, and adopted with some slight modifications. Copies of the rules will be sent, for comment, to electrical manufacturing companies, to the various associations interested, etc. The rules cover every wire entering a building from outside, of every class and character.

As the result of the good seen to accrue from organized work, the meeting proceeded to the formation, on a permanent basis, of the Underwriters' International Electrical Association, of which officers were elected as follows: Chas. E. Bliven, president; C. M. Goddard, secretary and treasurer.

The executive committee is to consist of a member appointed from each of the Underwriters' Associations.

An electrical committee was appointed for the purpose of adjudicating upon the technical questions that might be raised at any time and for pronouncing upon the value of any improvements in the art of insulation and its appliances or materials. Its members are: Messrs. F. E. Cabot, W. McDevitt, E. A. Fitzgerald, G. P. Low, A. E. Van Giesen and Leloup.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

THE 26th meeting of the American Society of Mechanical Engineers was held at the house of the Society, 12 west 31st street, November 29 to December 2 inclusive. Papers were read covering a wide range of subjects of interest to the members, though none of them contained matter having any practical bearing upon electrical subjects not already familiar to the readers of THE ELECTRICAL ENGINEER. Mr. R. C. Carpenter's paper on "Comparative Variation in Economy with Change of Load in Simple and Compound Engines" described a test in which the load employed was a Thomson-Houston generator delivering current to a water rheostat by means of which the resistance was varied to suit the conditions of the test.

The only distinctly electrical paper read was one by Mr. Anthony Victorin on the "Performance of an Overhead Traveling Crane Operated by a Single Electric Motor," and described that in use at the Watervliet Arsenal, West Troy, N. Y.

Between the sessions the members of the Society were pleasantly entertained in various ways and visited many points of special interest in the city and vicinity.

OBITUARY.

GEORGE H. MEEKER.

GREAT surprise and deep regret were expressed in this city at the sudden news of the death in Chicago of Mr. George H. Meeker, Western manager for the New York Insulated Wire Company. He was only 28 years old, and had but lately gone to Chicago to promote the interests with which he had for some time been connected. During a recent visit to New York, he contracted a cold, which on his return West developed serious symptoms, and in spite of all efforts he succumbed to peritonitis on December 5. He leaves a wife, but no children.

Mr. Meeker was a young man of much promise, bright, energetic, faithful, enterprising. He enjoyed the full confidence of his employers, and in return devoted his time and abilities wholly to the care of their large Western trade. Mr. Meeker was also public spirited, taking a lively concern in the prosperity of the Chicago Electric Club, and in the success of the electrical part of the World's Fair.

WILSON G. HUNT.

THE death is announced of Mr. Wilson G. Hunt, a retired and wealthy merchant of this city, at the age of 78. He was an active man of affairs for many years, and lent Prof. Morse his aid in the early days of the telegraph. He was at the time of his death a director in the Western Union Telegraph Company, and had also served as a director in more than one submarine cable company.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

Advertising is both wealth and fame to the judicious and liberal advertiser.

THE STANDARD ELECTRIC TIME COMPANY.

THE Standard Electric Time Company have contracted with the Cheney Bros., of South Manchester, Conn., to put in one of their new striking electric tower clocks, and a system of forty-eight electric dials, including the railroad depot and town hall. This will give South Manchester a uniform system of time that will be greatly appreciated, as all the dials will be controlled from one master clock, and this being corrected daily from observatory time signals will give correct and uniform time throughout the town and the works of the company.

A contract has also been signed for a large time plant, including an electric tower clock in the School for Deaf and Dumb at Fulton, Mo. This is the third institution of this kind to adopt the Warner system of electric time within a few months. The De La Vergne Refrigerating Machine Co., of New York, are also to adopt the Warner system, which is to displace another electric system which has not given satisfaction.

The electric tower clock made by this company, although a comparatively new thing, has given such general satisfaction in the past two years that it must supersede the old wind-up clock where exact time is required. Being controlled by a fine master clock in the building, the extremes of temperature have little or no effect upon the service. This company have not been so busy for months, and they are fast gaining a wide reputation for their system of time.

THE "PERFECT" ARC CUT-OUT.

THE latest bidder for popular favor is the new arc cut-out which the E. G. Bernard Company of Troy, New York, are at present making special efforts to push. This apparatus, shown in the accompanying illustrations, is of very simple construction and positive in action. It is made with a weatherproof case and with metal or glass face as desired. As originally made it contained wooden insulation, but porcelain is now used exclusively. The make and break does not depend on the quick motion of the hand of the operator, but has a very ingenious and quick acting spring attachment. The wire holes are in porcelain and the binding posts are fitted with a very novel shell-like clamp attachment which, it is claimed, make it impossible for the wires to become loose. A number of the largest stations in the country are at present using this cut-out with excellent results. The E. S. Greeley & Co., of this city, are the New York agents for this device.

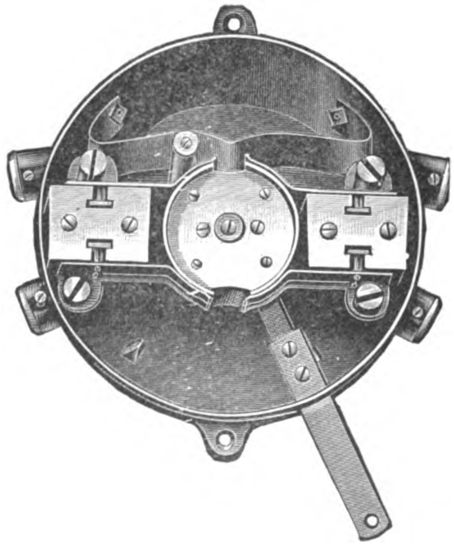


FIG. 1.—"PERFECT" ARC CUT-OUT.

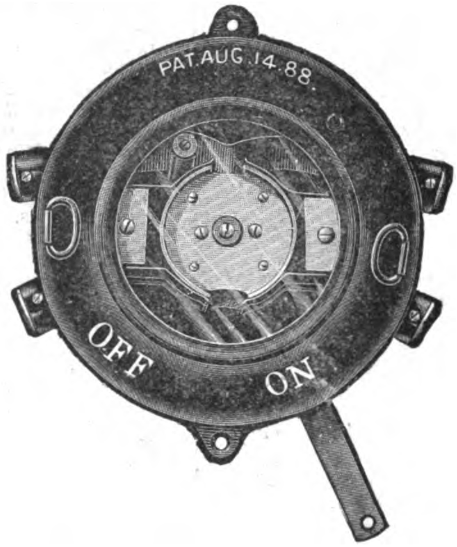


FIG. 2.—"PERFECT" ARC CUT-OUT.

ELECTRIC LIGHTING BIDS.

THE regular bids for electric lighting have been made in New York and Philadelphia, the rates in the latter case being a little lower than last year. There are no new bidders in New York, and prices for about 2,000 lights range from 40 up to 50 cents.

WESTERN NOTES.

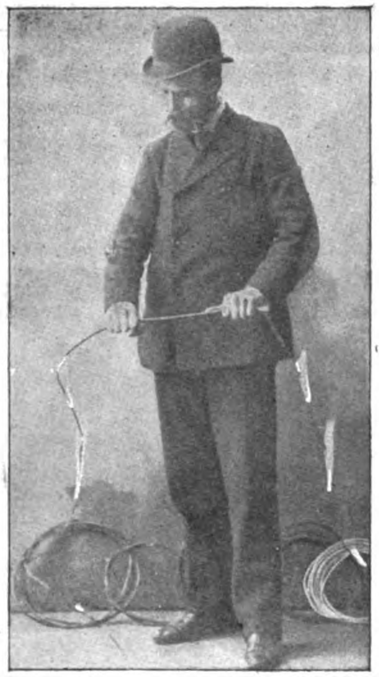
MR. C. M. GIDDINGS, president and general manager of the Sioux City Engine Works, Sioux City, Iowa, was among the World's Fair City visitors last week. Mr. Giddings reports having just completed the erection and starting up of one of their 24 x 48 Sioux City Corliss engines for the Burlington, Ia., Electric Light and Power Company. This is the smaller one of a pair originally designed for the station, the second of which will be a 500 h. p. compound condensing engine of same make. The engine is giving entire satisfaction. This company has also just secured a contract from the city of Hannibal, Mo., for a 22 x 48 Sioux City Corliss. The order was given to this company in the face of keen competition, after an inspection by the city council of the engines working at Dubuque, Ia. They have just ready for shipment to the Imperial Mill at Duluth, a 450 h. p. cross-compound Corliss. Business seems unusually good at this season of the year and prospects are excellent. They expect to enlarge their works very soon, the output of this year nearly doubling that of last.

MR. FRANK MCMASTER, traveling representative of George Cutter has returned from a Western trip during which he carried with him one of the new Cutter non-inductive volt meters and afforded the central station men convincing proof that the instrument is non-inductive and not subject to any temperature error. He reports that every one who saw it was greatly pleased with the way it worked. He also found business in all lines of specialties he carries very brisk and the outlook of a highly encouraging nature.

MR. HORACE A. CUSHING and Mr. Samuel F. B. Morse have been appointed general Western agents for Day's Kerite wire and cables, under the firm name of Cushing & Morse to succeed F. W. Cushing, who has resigned. Mr. F. W. Cushing goes to Europe on private business. Mr. Morse is a grandson of Prof. S. F. B. Morse, inventor of the telegraph.

MR. H. R. KINSELBACH, formerly of the Short Electric Company and late with the Electrical Construction Department of the World's Fair, has accepted a position as assistant superintendent with the Siemens and Halske Electric Company.

AN EXTRAORDINARY PERFORMANCE WITH "SALAMANDER" WIRE.



A MONTH or two ago some very interesting tests were made of a new insulated wire at the Edison station in this city before a body of experts and electrical insurance inspectors. This wire, known as the "Salamander," the invention of Mr. C. T. Snedekor, and manufactured by Washburn & Moen, was put through a series of tests with other wires, and remained practically intact, even when the others had gone up in smoke, and actually while the copper that it covered was melted out. During October, Mr. Snedekor made a similar exhibit at the Cleveland Street Railway Convention; and on November 1, in Boston, before a gathering of electrical men, he gave the startling performance illustrated in our cut. Taking a number of pieces of various insulated wires and joining them together, he had a current of 150 amperes passed through the circuit. As will be seen, the current destroyed the pieces shown bursting into flames, but the section of "Salamander" which Mr. Snedekor held in his hand, as shown, remained in a cool condition, so that in spite of the risk he would have run with ordinary wire, he was the calmest and least concerned member of the party.

It might be said that this remarkable exhibition was a mere tour de force, but it has now been made too often to be mere legerdemain; and it is understood that the manufacturers have subjected the wire for their own satisfaction to ordeals even more crucial as to its fireproof and waterproof qualities alike. The wire is not a low priced one, but the demand for it has already assumed very large proportions, and the facilities for production have been increased. Should the "Salamander" prove equal to the test of age, which there is little reason to doubt, it will be one of the most valuable additions of late years to the list of high class insulated wires.

McINTOSH, SEYMOUR & COMPANY.

MESSRS. McINTOSH, SEYMOUR & COMPANY, of Auburn, N. Y., still continue to run 23 hours a day, as they have done for the last four years, and have orders on hand for a good many engines, of which the principal ones are as follows:

One 1,200 h. p. double tandem compound condensing railway engine for the Syracuse Electric Light & Power Company, Syracuse, N. Y., with ball and socket self-oiling pillow block bearings and auxiliary shafts carrying the eccentrics and governor. This engine will have a wheel 7 feet face to carry two belts, and a shaft 16 inches in diameter. It will weigh 125 tons. One 600 h. p. four cylinder vertical triple expansion engine, for the Elmira Illuminating Company, Elmira, N. Y., fitted with double valves to each cylinder, one for the exhaust and compression, and the other for the admission and cut-off. Two 350 h. p. tandem compound condensing railway engines are also being made for the same company at Elmira.

One 600 h. p. double tandem compound, Hoboken Electric Light Company, Hoboken, N. J.; one 500 h. p. double tandem compound, Pennsylvania Railroad, Jersey City; two 500 h. p. standard, self-contained compound condensing, Citizens' General Electric Company, Louisville, Ky.; one 500 h. p. standard self-contained compound condensing, East River Electric Light Company, New York City; one 500 h. p. standard self-contained compound condensing, Edison Illuminating Company, New York City. The two last mentioned are the largest and heaviest self-contained compound engines made in the country. They weigh 40 tons each. The shafts are 11 inches in diameter; two 400 h. p. standard compound, Halifax Illuminating & Motor Company, Halifax, N. S.; one 350 h. p. standard self-contained compound, Consolidated Electric Light & Power Company, Dover, N. H.; one 250 h. p. standard compound, Baltimore Traction Company, Baltimore, M. D.; two 250 h. p. standard compound, City of Durban, South Africa; three 150 h. p. standard compound, Union Electricitats-Gesellschaft, Berlin, Germany; one 75 h. p. standard compound engine for Adolph Sutro, San Francisco, Cal.; one 200 h. p. single cylinder, Woburn Electric Light Company, Woburn, Mass.; one 200 h. p. single cylinder, Washington, D. C.; one 125 h. p. single cylinder, Cooperstown Electric Company, Cooperstown, N. Y.; one 150 h. p. single cylinder, Sing Sing, N. Y.; one 100 h. p. single cylinder, Lexington, Mass.; one 75 h. p. direct coupled single cylinder, North Chicago Street Railway Company, Chicago, Ill.; three 55 h. p. single cylinder, East River Gas Company, New York City, and other small engines.

They are also making a 1,200 h. p. engine for the World's Fair, to be direct belted, and one direct coupled 300 h. p. railroad engine, and one 300 h. p. direct coupled alternating outfit.

ELECTRIC FIXTURES OF THE NEW JERSEY LAMP AND BRONZE WORKS.

AN extensive gas and electric fixture department has been established by the above works at New Brunswick, N. J., under Mr. G. Wilfred Pearce, superintendent, the special department being in charge of Mr. Ralph W. Booth as general manager. This branch promises to become very important in the immediate future, and is already doing admirable work with excellent results. The factory is a fine four-story brick building, employing ordinarily from 150 to 200 hands, and the number runs much higher in the season.

The Works have a most complete line of fixtures, and keep a corps of experienced and skilful designers at work on new ideas all the time. The management is fully aware of the higher artistic taste now shown by the public in these matters, and is in closest sympathy with every demand for beauty of form and exquisite finish.

A special catalogue of electrical fixtures has just been issued by the works, and gives a good idea of their productions, being handsomely illustrated and tastefully printed. We reproduce herewith two or three of the designs intended for use as standards for newel posts, etc., and to carry either the common incandescent lamp or that which is now made up as a wax taper. These are but examples of a great variety, and we would recommend our readers to see the fixtures for themselves or to write for a copy of the beautiful catalogue. An industry thus aiming to put artistic products within everybody's reach at moderate prices is worthy of hearty support.

ELECTRIC FIXTURES OF THE NEW JERSEY LAMP AND BRONZE WORKS.

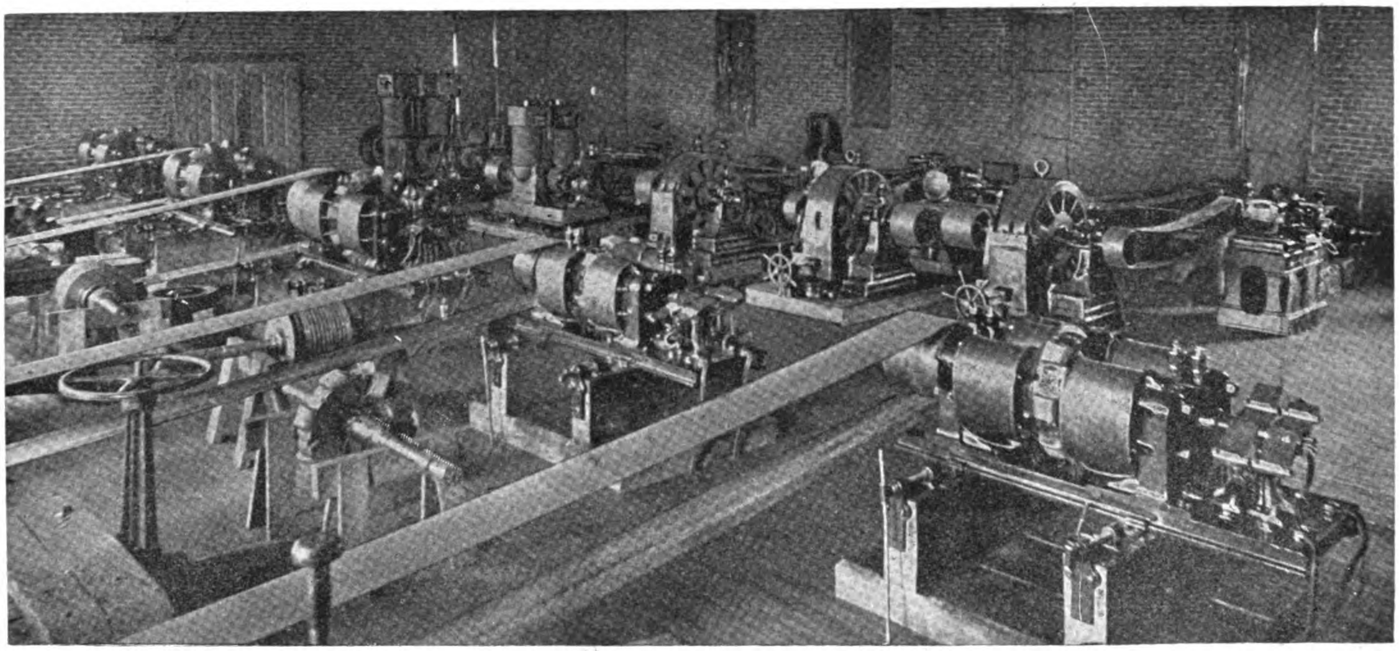
PELTON WATER WHEELS AT ROARING FORK, COLORADO.

One of the first attempts to operate the machinery of mills and mines by electric transmission on a large scale was that made by the Roaring Fork Electric Light and Power Company, at Aspen, Colorado, a part of whose plant is shown in the accompanying illustration.

The power station is located near the mining town of Aspen, in the heart of the Rocky Mountain range—a place of some 7,000 inhabitants—having an elevation of nearly 8,000 feet. Water is brought to the station in a single line of pipe consisting of 500 feet of 16 inch, and 3,500 feet of 14 inch—which discharges into a receiver from which short connections are made to the wheels. The power plant consists of eight 24 inch Pelton wheels which run 1,000 revolutions under a head of 820 feet, with a maximum capacity of 175 h. p. each, aggregating some 1,400 h. p.

Each wheel runs a separate generator, and connection is made by belt direct without intermediate gearing, the power developed being made to conform to the requirements by the use of reducing tips so that only as much water is applied to the wheels as is necessary to run the generators at proper speed.

The wheels weigh but 90 lbs. each and therefore show a capacity of nearly 2 h. p. for every pound of material and including accessories to make the plant complete, such as shafting, boxes, pulleys, gates, nozzles, etc., the proportion would be 4½ lbs. to every h. p. developed. Excellent regulation is afforded by the Doolittle automatic governor which controls the speed of the wheels perfectly under wide variations of load and what are regarded as very exacting conditions generally.



Electric Transmission Plant for All Services, Aspen, Colorado.

The light plant consists of three Brush 60-light arc dynamos, two Brush 450-light incandescent dynamos, of three Westinghouse alternating current machines of 750 lights each. The entire town of Aspen is lighted from this station as well as many mills, mines and sampling works in the vicinity.

The power plant consists of one 80 k. w. and one 40 k. w. Edison power generator. The power thus generated is used for operating mills, hoists, pumps, tramways, etc., as well as various other mining operations within a radius of three to four miles from the generating station.

This station has been in continuous operation for three years with practically no expense in the way of repairs nor interruption of any moment to the service, notwithstanding the severity of the weather encountered in such an altitude during a part of the year.

THE CONCORD LAND AND WATER-POWER COMPANY.

For some time the Concord Land and Water-Power Company have held the valuable property at Sewall's Falls, N. H., with the intention of utilizing the power for electrical transmission. A dam 500 feet long, of the very best possible construction, designed by Messrs. H. F. Mills, C. E., Lawrence, Mass., and E. F. Smith, C. E., Reading, Pa., assisted also by J. R. Freeman, C. E., 31 Milk street, Boston, is now being constructed there by Wm. H. Ward, contractor. It is about half done and is rapidly approaching completion. When completed it will give 5,000 h. p.

The Company have, at present, contracts for a very large amount of electrical work and a power house 150 feet x 40 feet will be constructed. The water wheels are to be furnished by the Rodney-Hunt Machine Company, of Orange, Mass.

The Company have secured the contract for lighting Concord for a term of ten years, and are temporarily doing the work by a steam plant arranged for the purpose. The other contracts consist of a large amount of motor service, including the new works of the Page Belting Company, and a portion of their old works, which will require eight motors, and a large amount of work upon the granite quarries, and in the granite sheds for polishing, cutting, etc. This is in addition to many motors in the city of Concord for manufacturing and other purposes.

A large amount of commercial lighting, both arc and incandescent, has been contracted for, and the company will start with a business which, they consider, will assure their financial success.

THE USE OF 500-VOLT MOTORS.

Mr. G. M. Angier, the general agent of the Mather Electric Company, writes us as follows:

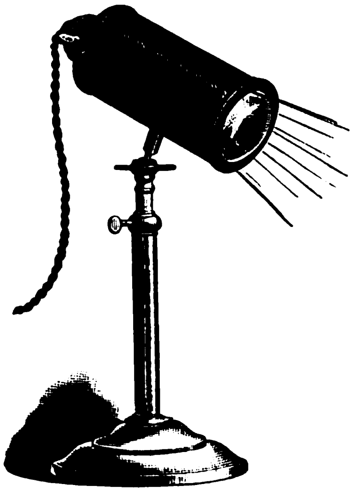
"We note with interest the editorial which appeared in your issue of last week regarding 500-volt motors. We find that the demand for motors wound for that voltage is rapidly increasing, and central station manufacturers and others are gradually adopting 500-volts as a standard potential for motor circuits. Up to within two years ago nine-tenths of the motors built by us were wound for 210 or 220 volts. To-day the case is reversed. Nearly all our motors are wound for 500 volts.

"Customers find the distribution of current can be accomplished more economically than with the lower voltages. The motor runs better and at a more constant speed. Carbon brushes may be used to better advantage; thus greatly reducing the wear of the commutator.

"Factories located in the vicinity of water powers are gradually adopting electricity for power purposes. Of course its advantages are many. Shafting, belting, etc., are entirely done away with. The different departments can be operated entirely independently of each other. With the lower voltages it was almost impossible to carry current any distance, and factories located within a mile or two of a splendid water power were obliged to use steam. With a voltage of 500 the question is easily solved and can be economically accomplished. Many central stations are installing and operating independent motor circuits, and in the majority of such cases they have adopted a potential of 500 volts.

"The great trouble with many of the 500-volt motors that were first placed on the market was the question of insulation. This, however, has been entirely overcome, and to-day the 500-volt motor certainly has many advantages over those wound for 210 or 220 volts."

THE DELAVAN LARYNGOSCOPIC ELECTRIC LIGHT CONDENSER FOR PHYSICIANS.



Delavan Laryngoscope.

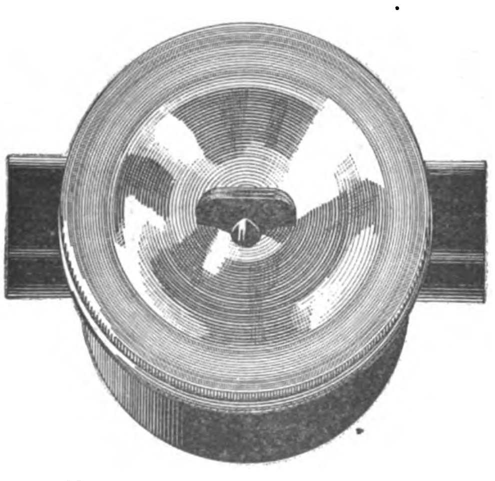
THE proceedings of the American Electro-Therapeutical Association prove abundantly that the leading members of the medical profession have at last recognized the great value of electricity, both as a remedial agent, and as a practical means of performing many of the minor surgical operations which were formerly done with the knife and the cautery iron. In order to keep step with the ever increasing demands of the profession, the supply trade have had to turn more particular attention to this branch of the business, and among others, the Edison Manufacturing Company are now turning out many novelties which will prove of interest to the profession.

They have recently perfected an optical condenser devised by them for Dr. Delavan, of this city, for use with the street current, which throws a perfectly clear beam from the head mirror, doing away with the shadow which is invariably thrown from the incandescent lamp, as ordinarily used.

The accompanying engraving will give a general idea of the outfit. The condenser is attached with a ball and socket to an adjustable standard, enabling the physician to use it at any height or angle required. It can be seen in operation at the offices of the company, No. 110 East Twenty-third street, New York City.

A NEW "E. E. & S." SNAP SWITCH.

THE accompanying illustration shows an incandescent snap switch neatly encased in an iron receptacle, made by the Electric Engineering and Supply Company, of Syracuse, N. Y. It is especially designed for the conduit system of wiring, and the receptacle will admit a 5 and 10 ampere switch, either single or double pole. They are made in a variety of styles and can be located almost anywhere on the line, and have openings to accommodate any sized tube, single or duplex. The receptacle can be inserted into the walls when the building is in course of erection, and the switch put in and connection made at any time thereafter to suit the convenience of the builder. The covers are concave, forming a deep recess, by means of which the key or thumb piece is set into the receptacle and does not protrude from the wall. This cover is easily removed by detaching the key and then a slight turn in either direction will lay the switch open for inspection or making connection. A highly polished ring encircles the opening of the box, and protects the decoration or frescoing from soiled hands when the cover is removed for repair. The receptacle is furnished with E. E. & S. switches especially constructed for the purpose. The cover can be furnished to match any other hardware.

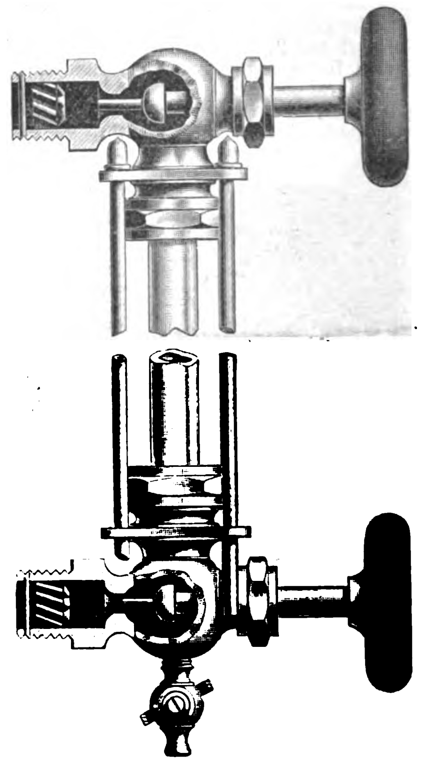


NEW "E. E. & S." SNAP SWITCH.

The same idea is applied to ceiling cut-outs, and a receptacle a little differently constructed is equipped with the E. E. & S. rosette, especially made for this design. Here a convex cover is used provided at the centre with a hard rubber insulating bushing through which the cord passes. A number of the large buildings recently erected in New York are fitted up with these devices.

THE ASHLEY AUTOMATIC WATER GAUGE.

THE accompanying illustration represents a sectional view of a new automatic water gauge manufactured by the Ashley Engineering Company, of Hawthorne, N. J., whose New York office is at 186 Liberty street. A particular point of interest is noticed in the pipe leading to the glass gauge, which has a round plug or valve, having on its outer radius spiral wings or flanges; while the glass remains unbroken the water continues balanced on the water line by the steam in the upper part of the gauge; upon breaking the glass, however, the rush of steam and water to the atmosphere carries the sliding valve to the seat, as shown in the illustration. By adjusting the pin at the end of the outer valve so that the steam gets a vent through the valve seat, and alternately opening and closing the outer valve, the steam rapidly revolves the inner or rotating valve and, as it comes to its seat, it regrinds the valve seat each time the process is repeated, and at the same time cleans the valve chamber from all deposit or sediment.



ASHLEY AUTOMATIC WATER GAUGE.

It is claimed that with these gauges in use there is absolutely no danger of being scalded as is the case in breakage. Should the glass be broken during the night, as is often the case, the steam and water are instantly shut off. The device will undoubtedly prove of value to engineers of central and power stations.

QUICK WORK BY THE DIRECT CABLE COMPANY.

THE United Press, having occasion on the forenoon of Dec. 8, to send to the Central News, London, an inquiry relating to some ordinary business matter, filed a dispatch at the office of the Direct Cable Company in this city, and in exactly ten and one-half minutes afterward a reply was laid on the desk of General Manager Phillips. Quicker work than this has, of course, often been done not only by the Direct Company, but by the other cable companies as well, but the foregoing record has seldom been equalled except when extraordinary effort to do so has been made. This was in the regular, humdrum course of business.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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ON THE DISSIPATION OF THE ELECTRICAL ENERGY OF THE HERTZ RESONATOR.

BY

Nikola Tesla

ANYONE who, like myself, has had the pleasure of witnessing the beautiful demonstrations with vibrating diaphragms which Prof. Bjerknes, exhibited in person at the Paris Exposition in 1889, must have admired his ability and painstaking care to such a degree, as to have an almost implicit faith in the correctness of observations made by him. His experiments "On the Dissipation of the Electrical Energy of the Hertz Resonator," which are described in the issue of Dec. 14, of THE ELECTRICAL ENGINEER, are prepared in the same ingenious and skillful manner, and the conclusions drawn from them are all the more interesting as they agree with the theories put forth by the most advanced thinkers. There can not be the slighest doubt as to the truth of these conclusions, yet the statements which follow may serve to explain in part the results arrived at in a different manner; and with this object in view I venture to call attention to a condition with which, in investigations such as those of Prof. Bjerknes, the experimenter is confronted.

The apparatus, oscillator and resonator, being immersed in air, or other discontinuous medium, there occurs—as I have pointed out in the description of my recent experiments before the English and French scientific societies—dissipation of energy by what I think might be appropriately called *electric sound waves* or *sound-waves of electrified air*. In Prof. Bjerknes's experiments principally this dissipation in the resonator need be considered, though the sound-waves—if this term be permitted—which emanate from the surfaces at the oscillator may considerably affect the observations made at some distance from the latter. Owing to this dissipation the period of vibration of an air-condenser can not be accurately determined, and I have already drawn attention to this important fact.

These waves are propagated at right angles from the charged surfaces when their charges are alternated, and dissipation occurs, even if the surfaces are covered with thick and excellent insulation. Assuming that the "charge" imparted to a molecule or atom either by direct contact or inductively is proportionate to the electric density of the surface, the dissipation should be proportionate to the square of the density and to the number of waves per second. The above assumption, it should be stated, does not agree with some observations from which it appears that an atom can not take but a certain maximum charge; hence, the charge imparted may be practically independent of the density of the surface, but this is immaterial for the present consideration. This and other points will be decided when accurate quantitative determinations, which are as yet wanting, shall be made. At present it appears certain from experiments with high-frequency currents, that this dissipation of energy from a wire, for instance, is not very far from being proportionate to the frequency of the alternations, and increases very rapidly when the diameter of the wire is made exceedingly small. On the latter point the recently published results of Prof. Ayrton and H. Kilgour on "The Thermal Emissivity of Thin Wires in Air" throw a curious light. Exceedingly thin wires are capable of dissipating a comparatively very great amount of energy by the agitation of the surrounding air, when they are connected to a source of rapidly alternating potential. So in the experiment cited, a thin hot wire is found to be capable of emitting an extraordinarily great amount of heat, especially at elevated temperatures. In the case of a hot wire it must of course be assumed that the increased emissivity is due to the more rapid convection and not, to any appreciable degree, to an increased radiation. Were the latter demonstrated, it would show that a wire, made hot by the application of heat in ordinary ways, behaves in some respects like one, the charge of which is rapidly alternated, the dissipation of energy per unit of surface kept at a certain temperature depending on the curvature of the surface. I do not recall any record of experiments intended to demonstrate this, yet this effect, though probably very small, should certainly be looked for.

A number of observations showing the peculiarity of very thin wires were made in the course of my experiments. I noted, for instance, that in the well-known Crookes instrument the mica vanes are repelled with comparatively greater force when the incandescent platinum wire is exceedingly thin. This observation enabled me to produce the spin of such vanes mounted in a vacuum tube when the latter was placed in an alternating electrostatic field. This however does not prove anything in regard to radiation, as in a highly exhausted vessel the phenomena are principally due to molecular bombardment or convection.

When I first undertook to produce the incandescence of a wire enclosed in a bulb, by connecting it to only *one* of the terminals of a high tension transformer, I could not succeed for a long time. On one occasion I had mounted in a bulb a thin platinum wire, but my apparatus was not adequate to produce the incandescence. I made other bulbs, reducing the length of the wire to a small fraction; still I did not succeed. It then occurred to me that it would be desirable to have the surface of the wire as large as possible, yet the bulk small, and I provided a bulb with an exceedingly thin wire of a bulk about equal to that of the short but much thicker wire. On turning the current on the bulb the wire was instantly fused. A series of subsequent experiments showed, that when the diameter of the wire was exceedingly small, considerably more energy would be dissipated per unit surface at all degrees of exhaustion than was to be expected, even on the assumption that the energy given off was in proportion to the square of the electric density. There is likewise evidence which, though not possessing the certainty of an accurate quantitative determination, is nevertheless reliable because it is the result of a great many observations, namely, that with the increase of the density the dissipation is more rapid for thin than for thick wires.

The effects noted in exhausted vessels with high-frequency currents are merely diminished in degree when the air is at ordinary pressure, but heating and dissipation occurs, as I have demonstrated, under the ordinary atmospheric conditions. Two very thin wires attached to the terminals of a high-frequency coil are capable of giving off an appreciable amount of energy. When the density is very great, the temperature of the wires may be perceptibly raised, and in such case probably the greater portion of the energy which is dissipated *owing to the presence of a discontinuous medium* is transformed into heat at the surface or in close proximity to the wires. Such heating could not occur in a medium possessing either of the two qualities, namely, perfect incompressibility or perfect elasticity. In fluid insulators, such as oils, though they are far from being perfectly incompressible or elastic to electric displacement, the heating is much smaller because of the continuity of the fluid.

When the electric density of the wire surfaces is small, there is no appreciable local heating, nevertheless energy is dissipated in air by waves, which differ from ordinary sound-waves only because the air is electrified. These waves are especially conspicuous when the discharges of a powerful battery are directed through a short and thick metal bar, the number of discharges per second being very small. The experimenter may feel the impact of the air at distances of six feet or more from the bar, especially if he takes the precaution to sprinkle the face or hands with ether. These waves cannot be entirely stopped by the interposition of an insulated metal plate.

Most of the striking phenomena of mechanical displacement, sound, heat and light which have been observed, imply the presence of a medium of a gaseous structure, that is, one consisting of independent carriers capable of free motion.

When a glass plate is placed near a condenser the charge of which is alternated, the plate emits a sound. This sound is due to the rythmical impact of the air against the plate. I have also found that the ringing of a condenser, first noted by Sir William Thomson, is due to the presence of the air between or near the charged surfaces.

When a disruptive discharge coil is immersed in oil contained in a tank, it is observed that the surface of the oil is agitated. This may be thought to be due to the displacements produced in the oil by the changing stresses, but such is not the case. It is the air above the oil which is agitated and causes the motion of the latter; the oil itself would remain at rest. The displacements produced in it by changing electrostatic stresses are insignificant; to such stresses it may be said to be compressible to but a very small degree. The action of the air is shown in a curious manner for if a pointed metal bar is taken in the hand and held with the point close to the oil, a hole two inches deep is formed in the oil by the molecules of the air, which are violently projected from the point.

The preceding statements may have a general bearing upon investigations in which currents of high frequency and potential are made use of, but they also have a more direct bearing upon the experiments of Prof. Bjerknes which are here considered, namely, the "skin effect," is increased by the action of the air. Imagine a wire immersed in a medium, the conductivity of which would be some function of the frequency and potential difference but such, that the conductivity increases when either or both of these elements are increased. In such a medium, the higher the frequency and potential difference, the greater will be the current which will find its way through the surrounding medium, and the smaller the part which will pass through the central portion of the wire. In the case of a wire immersed in air and traversed by a high-frequency current, the facility with which the energy is dissipated may be considered as the equivalent of the conductivity; and the analogy would be quite complete, were it not that besides the air another medium is present, the total dissipation being merely modified by the presence of the air to an extent as yet not ascertained. Nevertheless, I have sufficient evidence to draw the conclusion, that the results obtained by Prof. Bjerknes are affected by the presence of air in the following manner: 1. The dissipation of energy is more rapid when the resonator is immersed in air than it would be in a practically continuous medium, for instance, oil. 2. The dissipation owing to the presence of air renders the difference between magnetic and non-magnetic metals more striking. The first conclusion follows directly from the preceding remarks; the second follows from the two facts that the resonator receives always the same amount of energy, independent of the nature of the metal, and that the magnetism of the metal increases the impedance of the circuit. A resonator of magnetic metal behaves virtually as though its circuit were longer. There is a greater potential difference set up per unit of length, although this may not show itself in the deflection of the electrometer owing to the lateral dissipation. The effect of the increased impedance is strikingly illustrated in the two experiments of Prof. Bjerknes when copper is deposited upon an iron wire, and next iron upon a copper wire. Considerable thickness of copper deposit was required in the former experiment, but very little thickness of iron in the latter, as should be expected.

Taking the above views, I believe, that in the experiments of Prof. Bjerknes which lead him to undoubtedly correct conclusions, the air is a factor fully as important, if not more so, than the resistance of the metals.

STATISTICS OF ELECTRICAL MANUFACTURE IN GERMANY.

THE following statistics with regard to the value of electrical goods manufactured in Germany, and relating to the years 1890 and 1891, were recently given by the *Elektrotechnische Zeitschrift* on the authority of Herr Fr. Vogel. Telegraphic apparatus to the value of $280,000 was made; telephones, over $400,000; railway signalling apparatus, nearly $400,000; total, with electric bells, etc., about $2,000,000. During 1890–1891: 3,500 continuous current dynamos, alternators and transformers were built each year to the value of $1,600,000. In 1886 a large German firm built 350 machines, having a total output of 2,500,000 watts. Last year the same firm turned out 760 machines, the total output of which was 10,000,000 watts, the average size of machine being, therefore, about 9½ h. p. and 17½ h. p. respectively. Accumulators are being manufactured and sold in Germany to the amount of $1,120,000 per annum. About 17,000 arc lamps are made every year, their value being about $500,000. The arc-light carbon product amounts to nearly $400,000 per annum, and the incandescent lamp product to $640,000. The value of the total annual electrical output of all sorts is placed at $6,600,000 or $6,700,000. The number of persons employed in electrical factories is about 15,000.

MAXIMUM SPEED ON ELECTRIC RAILWAYS.

IN a contribution to the *Elektrotechnische Zeitschrift*, Mr. J. Kraemer comments on the current statements regarding high speed on electric railways, and presents an array of formulas for calculating the effect of air pressure, dead weight and other factors on the maximum possible speed. He thinks that 500 kilometres per hour is the highest speed yet attained by experiments made on a laboratory scale; the dead weight of the cars, engine, trucks and the fuel used reduces this to about 150 kilometres. The limited rate of reciprocation of the steam engine part of the locomotive suggests larger driving wheels, but the size of these is limited by the radius of the curves. These factors, together with the allowances for air resistance, slipping on the rails and the average grades still further reduce this speed, so that electric railways must be able to alter the conditions materially in order to attain a speed of even 200 kilometres per hour, corresponding to about 125 miles per hour—quite a promising figure.

TABLES SHOWING PERMISSIBLE AMPERAGE AND DEPTH OF WINDING FOR COTTON COVERED WIRE.

BY

Walter S. Dix

On pages 818 and 819 of the fourth edition of Thompson's "Dynamo-Electric Machinery," is given an "Amperage Table," based upon current densities of 1,000 to 4,000 amperes per square inch of copper in conductors. As this basis is purely arbitrary and moreover does not, in most cases, agree with the best practice, the writer has calculated the accompanying tables, founded upon a more rational idea, viz., the rate of emissivity for a given rise of temperature.

For armatures, it is approximately correct to say that .9 of a watt per square inch will be dissipated for a rise in temperature of 35° C., that being the result of Esson's experiments (Thompson, page 429); while .4 of a watt per square inch is dissipated in stationary magnets for a rise of 35° C., both figures being borne out by experience as substantially correct.

Table I is calculated for an emissivity of .9 watt per square inch and for *double* cotton covered wire, which is almost always used in armatures. Table II is calculated for an emissivity of .4 watt, and for *single* cotton covered wire, as being most frequently employed for magnets,

TABLE II.

PERMISSIBLE AMPERAGE

AND

PERMISSIBLE DEPTH OF WINDING

FOR

MAGNETS WITH SINGLE COTTON COVERED WIRE.

Gauge		Diam. Bare, Inches	Circular Mils.	Ohms per Foot at 60° C.	Lbs. per Foot		Turns per Linear Inch	Layers																																					
B&S	Bir				Bare	Covered		1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		19		20	
								Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth
	2	.284	80656	.0001495	.244		3.44	96.7	.291	68.3	.56	55.8	.80	48.4	1.05	43.2	1.30	39.5	1.55	36.5	1.81	34.2	2.06	32.2	2.31	30.7	2.57	29.2	2.82	28.0	3.08	26.8	3.33	25.8	3.58	25.0	3.84	24.2	4.08	23.4	4.34	22.8	4.60	22.2	4.85	21.6	5.10
	3	.259	67081	.000180	.203		3.76	84.3	.266	59.6	.50	48.6	.73	42.2	.96	37.7	1.19	34.4	1.42	31.8	1.65	29.8	1.89	28.1	2.12	26.7	2.35	25.4	2.58	24.3	2.81	23.4	3.04	22.6	3.28	21.8	3.51	21.1	3.74	20.4	3.97	19.9	4.20	19.3	4.44	18.9	4.67
2		.2576	66373	.000182	.201		3.78	83.6	.2646	59.1	.50	48.2	.73	41.8	.96	37.4	1.17	34.1	1.41	31.6	1.64	29.6	1.87	27.9	2.10	26.5	2.34	25.2	2.57	24.1	2.80	23.2	3.03	22.4	3.26	21.6	3.49	20.9	3.72	20.3	3.95	19.7	4.18	19.2	4.42	18.7	4.64
	4	.238	56644	.000213	.172		4.08	74.3	.245	52.5	.46	42.8	.67	37.1	.89	33.2	1.10	30.3	1.31	28.1	1.52	26.1	1.74	24.8	1.95	23.6	2.16	22.4	2.38	21.4	2.59	20.6	2.80	19.9	3.02	19.2	3.23	18.6	3.44	18.0	3.66	17.5	3.87	17.0	4.08	16.6	4.29
3		.2294	52634	.000229	.159		4.23	70.4	.2364	49.8	.44	40.6	.65	35.2	.86	31.2	1.06	28.8	1.26	26.6	1.47	24.9	1.67	23.5	1.88	22.3	2.09	21.2	2.29	20.3	2.50	19.5	2.71	18.8	2.91	18.2	3.12	17.6	3.32	17.0	3.53	16.6	3.73	16.2	3.94	15.7	4.15
	5	.22	48400	.000249	.146		4.41	66.2	.227	46.8	.43	38.2	.62	33.1	.82	29.6	1.02	27.0	1.21	25.0	1.41	23.4	1.61	22.1	1.81	21.0	2.00	20.0	2.20	19.1	2.40	18.4	2.60	17.7	2.80	17.1	2.99	16.6	3.19	16.0	3.39	15.6	3.58	15.2	3.78	14.8	3.98
4		.2043	41743	.000289	.126	.143	4.73	59.3	.2113	41.9	.40	34.2	.58	29.6	.76	26.5	.95	24.2	1.13	22.4	1.31	21.0	1.50	19.8	1.68	18.8	1.86	17.9	2.05	17.1	2.23	16.4	2.42	15.8	2.60	15.3	2.78	14.8	2.97	14.4	3.15	14.0	3.33	13.6	3.52	13.25	3.71
	6	.203	41209	.000292	.125		4.76	58.8	.210	39.5	.39	33.9	.58	29.9	.76	26.2	.94	24.0	1.12	22.2	1.31	20.8	1.49	19.6	1.67	18.6	1.85	17.7	2.04	16.9	2.22	16.3	2.40	15.7	2.59	15.2	2.77	14.7	2.95	14.2	3.14	13.9	3.32	13.5	3.50	13.15	3.68
5		.1819	33102	.000365	.100	.111	5.29	49.9	.189	35.3	.36	28.8	.52	24.9	.68	22.3	.85	20.4	1.01	18.8	1.18	17.7	1.34	16.6	1.50	15.8	1.67	15.0	1.83	14.4	2.00	13.8	2.16	13.3	2.33	12.9	2.49	12.5	2.66	12.1	2.82	11.8	2.99	11.4	3.15	11.15	3.32
	7	.18	32400	.0002725	.0979		5.35	49.1	.187	34.7	.35	28.3	.51	24.5	.67	21.9	.84	20.0	1.00	18.5	1.16	17.3	1.33	16.4	1.49	15.5	1.65	14.8	1.81	14.1	1.98	13.6	2.14	13.1	2.30	12.7	2.46	12.27	2.63	11.9	2.79	11.6	2.95	11.2	3.12	10.95	3.28
	8	.165	27225	.000443	.0825		5.81	43.2	.172	30.5	.32	24.9	.47	21.6	.62	19.3	.77	17.6	.92	16.3	1.07	15.3	1.22	14.4	1.37	13.7	1.52	13.0	1.67	12.5	1.82	12.0	1.97	11.5	2.12	11.1	2.27	10.80	2.42	10.5	2.57	10.2	2.72	9.92	2.87	9.66	3.02
6		.162	26251	.000459	.0794	.0869	5.92	42.1	.169	29.7	.32	24.2	.46	21.1	.61	18.8	.76	17.2	.90	15.9	1.05	14.9	1.20	14.0	1.34	13.3	1.49	12.7	1.64	12.1	1.79	11.7	1.94	11.2	2.08	10.85	2.23	10.52	2.38	10.2	2.52	9.94	2.67	9.65	2.82	9.41	2.96
	9	.148	21904	.000551	.0663		6.45	36.8	.155	26.0	.29	21.2	.43	18.4	.56	16.4	.70	15.0	.83	13.9	.96	13.0	1.10	12.3	1.23	11.65	1.37	11.1	1.50	10.6	1.64	10.2	1.77	9.83	1.91	9.50	2.04	9.20	2.18	8.93	2.31	8.68	2.45	8.45	2.58	8.23	2.72
7		.1443	20817	.0005795	.0628	.0714	6.61	35.4	.1513	25.0	.28	20.4	.42	17.7	.55	15.8	.68	14.4	.81	13.4	.94	12.5	1.07	11.8	1.20	11.21	1.33	10.66	1.47	10.2	1.60	9.82	1.73	9.46	1.86	9.15	2.00	8.85	2.13	8.58	2.26	8.35	2.39	8.13	2.52	7.92	2.65
	10	.134	17956	.000672	.0544		7.09	31.7	.141	22.4	.26	18.3	.39	15.8	.51	14.1	.63	12.9	.75	12.0	.88	11.2	1.00	10.6	1.12	10.04	1.24	9.56	1.37	9.15	1.49	8.79	1.61	8.48	1.74	8.18	1.86	7.92	1.98	7.68	2.10	7.48	2.23	7.27	2.35	7.08	2.47
8		.1285	16510	.000731	.0501	.0571	7.28	29.9	.1355	21.2	.25	17.2	.37	14.9	.49	13.3	.61	12.2	.72	11.3	.84	10.6	.96	9.99	1.08	9.40	1.20	9.02	1.31	8.63	1.43	8.30	1.55	7.99	1.67	7.72	1.78	7.47	1.90	7.25	2.02	7.06	2.14	6.86	2.26	6.68	2.38
	11	.12	14400	.000838	.0436		7.87	27.0	.127	19.1	.24	15.55	.35	13.5	.46	12.05	.57	11.0	.68	10.2	.79	9.56	.90	9.00	1.01	8.56	1.12	8.14	1.23	7.79	1.34	7.49	1.45	7.22	1.56	6.97	1.67	6.75	1.79	6.55	1.90	6.37	2.00	6.20	2.12	6.04	2.23
9		.1144	13094	.000922	.0393	.0454	8.24	25.1	.1214	17.8	.23	14.45	.33	12.57	.44	11.20	.54	10.2	.65	9.50	.75	8.90	.86	8.36	.97	7.95	1.07	7.57	1.18	7.25	1.28	6.96	1.39	6.71	1.50	6.48	1.60	6.27	1.71	6.08	1.81	5.92	1.92	5.76	2.02	5.61	2.13
	12	.109	11881	.001015	.0359		8.62	23.4	.116	16.6	.22	13.48	.32	11.70	.42	10.44	.52	9.55	.62	8.85	.72	8.28	.82	7.80	.92	7.44	1.02	7.06	1.12	6.75	1.23	6.49	1.33	6.25	1.43	6.05	1.53	5.85	1.63	5.67	1.73	5.52	1.83	5.37	1.93	5.23	2.04
10		.1019	10382	.001161	.0314	.0370	9.18	21.3	.1089	15.1	.204	12.26	.30	10.63	.39	9.53	.49	8.70	.58	8.05	.68	7.54	.77	7.10	.87	6.75	.96	6.43	1.06	6.15	1.15	5.91	1.25	5.70	1.34	5.50	1.44	5.32	1.53	5.17	1.62	5.03	1.72	4.88	1.81	4.76	1.91
	13	.095	9025	.001336	.0273		9.80	19.2	.102	13.56	.191	11.05	.28	9.60	.37	8.58	.46	7.84	.55	7.26	.64	6.80	.72	6.40	.81	6.08	.90	5.79	.99	5.54	1.08	5.33	1.17	5.13	1.26	4.96	1.34	4.80	1.43	4.66	1.52	4.53	1.61	4.41	1.70	4.29	1.79
11		.0907	8234	.001465	.0250	.0294	10.24	17.9	.0977	12.65	.183	10.60	.27	8.95	.35	8.00	.44	7.31	.53	6.77	.61	6.34	.69	5.99	.78	5.67	.86	5.40	.95	5.17	1.03	4.97	1.12	4.78	1.20	4.62	1.29	4.47	1.37	4.34	1.46	4.22	1.54	4.11	1.63	4.00	1.71
	14	.083	6889	.00175	.0208		11.36	15.37	.088	10.85	.165	8.86	.24	7.68	.32	6.86	.40	6.27	.47	5.82	.55	5.44	.62	5.12	.70	4.87	.78	4.63	.85	4.43	.93	4.26	1.01	4.10	1.08	3.96	1.16	3.84	1.24	3.72	1.31	3.62	1.39	3.53	1.47	3.44	1.54
12		.0808	6530	.001845	.0198	.0238	11.66	14.93	.0858	10.55	.161	8.62	.236	7.46	.31	6.67	.39	6.10	.46	5.65	.53	5.28	.61	4.98	.68	4.73	.76	4.50	.83	4.31	.91	4.14	.98	3.99	1.06	3.86	1.13	3.73	1.21	3.62	1.28	3.52	1.35	3.43	1.43	3.34	1.51
13	15	.072	5184	.002325	.0157	.0182	12.99	12.61	.077	8.92	.144	7.28	.212	6.30	.28	5.64	.35	5.15	.41	4.77	.48	4.47	.55	4.20	.61	4.00	.68	3.80	.75	3.64	.82	3.50	.88	3.37	.95	3.26	1.02	3.15	1.08	3.06	1.15	2.98	1.22	2.90	1.28	2.82	1.35
	16	.065	4225	.00286	.0128		14.29	10.84	.07	7.66	.131	6.26	.192	5.42	.25	4.85	.31	4.43	.38	4.10	.44	3.84	.50	3.61	.56	3.44	.62	3.27	.68	3.12	.74	3.01	.80	2.90	.86	2.80	.92	2.71	.98	2.63	1.04	2.56	1.10	2.72	1.17	2.42	1.23
14		.0641	4107	.002935	.0124	.0147	14.47	10.63	.0691	7.52	.129	6.14	.190	5.31	.25	4.75	.31	4.34	.37	4.02	.43	3.76	.49	3.21	.55	3.37	.61	3.20	.67	3.07	.73	2.95	.79	2.84	.85	2.74	.91	2.66	.97	2.58	1.03	2.51	1.09	2.44	1.15	2.37	1.21
	17	.058	3364	.00358	.0102		15.87	9.19	.063	6.50	.118	5.30	.173	4.59	.23	4.19	.28	3.75	.34	3.48	.39	3.25	.45	3.06	.50	2.91	.56	2.77	.61	2.65	.67	2.55	.72	2.46	.78	2.37	.83	2.30	.89	2.23	.94	2.17	.995	2.11	1.05	2.06	1.11
15		.0571	3257	.00370	.00986	.0115	16.10	8.98	.0621	6.34	.116	5.18	.170	4.49	.224	4.02	.28	3.66	.33	3.40	.38	3.18	.44	2.99	.49	2.85	.55	2.71	.60	2.59	.66	2.49	.71	2.40	.77	2.32	.82	2.24	.87	2.18	.93	2.12	.98	2.06	1.03	2.01	1.09
16		.0508	2583	.004665	.00783	.00909	17.92	7.58	.0550	5.36	.105	4.37	.153	3.79	.202	3.38	.25	3.10	.30	2.87	.35	2.68	.40	2.53	.45	2.40	.49	2.29	.54	2.19	.59	2.10	.64	2.03	.69	1.96	.74	1.89	.79	1.84	.84	1.79	.88	1.74	.93	1.695	.98
	18	.049	2401	.005025	.00728		18.52	7.18	.054	5.08	.101	4.14	.148	3.59	.195	3.21	.242	2.93	.29	2.72	.34	2.54	.38	2.39	.43	2.28	.48	2.16	.52	2.07	.57	1.99	.62	1.92	.67	1.85	.71	1.79	.76	1.74	.81	1.69	.85	1.65	.90	1.605	.95
17		.0453	2048	.00589	.00620	.00714	19.88	6.41	.0503	4.53	.094	3.69	.138	3.21	.181	2.86	.226	2.62	.27	2.48	.31	2.27	.36	2.14	.40	2.08	.44	1.99	.49	1.85	.53	1.76	.58	1.71	.62	1.65	.66	1.60	.71	1.55	.75	1.51	.80	1.47	.84	1.430	.88
	19	.042	1764	.00684	.00536		21.23	5.75	.047	4.06	.088	3.32	.129	2.87	.170	2.57	.211	2.35	.25	2.17	.29	2.04	.34	1.92	.37	1.82	.42	1.73	.46	1.66	.50	1.59	.54	1.54	.58	1.48	.62	1.44	.66	1.39	.70	1.35	.74	1.32	.78	1.285	.82
18		.0403	1624	.00742	.00493	.00571	22.08	5.41	.0453	3.82	.085	3.12	.124	2.71	.164	2.42	.203	2.21	.24	2.04	.28	1.91	.32	1.80	.36	1.71	.40	1.63	.44	1.56	.48	1.50	.52	1.44	.56	1.40	.60	1.35	.64	1.31	.68	1.27	.72	1.24	.76	1.209	.80
19		.0359	1288	.00935	.00389	.00455	24.45	4.52	.0409	3.24	.077	2.65	.112	2.29	.148	2.05	.183	1.87	.22	1.74	.25	1.62	.29	1.53	.33	1.46	.36	1.38	.40	1.32	.43	1.27	.47	1.23	.51	1.18	.54	1.15	.58	1.11	.61	1.08	.65	1.05	.68	1.026	.72
	20	.035	1225	.00983	.00370		25.00	4.42	.04	3.12	.075	2.55	.110	2.21	.144	1.97	.179	1.80	.21	1.67	.25	1.56	.28	1.47	.32	1.40	.35	1.33	.39	1.27	.42	1.22	.46	1.18	.49	1.14	.53	1.105	.55	1.07	.60	1.04	.63	1.01	.67	.987	.70
20	21	.032	1024	.0118	.00310	.00357	27.03	3.86	.037	2.74	.069	2.24	.102	1.94	.137	1.73	.166	1.58	.198	1.47	.23	1.37	.26	1.29	.29	1.26	.33	1.17	.36	1.12	.39	1.075	.42	1.04	.46	1.00	.49	.970	.52	.941	.55	.916	.58	.891	.62	.867	.65
21		.0285	810	.0149	.00246	.00278	29.85	3.28	.0335	2.32	.063	1.89	.092	1.64	.121	1.46	.150	1.34	.179	1.24	.21	1.16	.24	1.09	.27	1.04	.30	.989	.33	.946	.35	.910	.38	.877	.41	.847	.44	.820	.47	.795	.50	.774	.53	.753	.56	.733	.59
	22	.028	784	.01535	.00237		30.30	3.21	.033	2.27	.062	1.85	.091	1.60	.119	1.43	.148	1.31	.176	1.21	.205	1.135	.23	1.07	.26	1.017	.29	.968	.32	.926	.35	.890	.38	.858	.41	.829	.44	.802	.45	.778	.49	.757	.52	.737	.55	.717	.58
22		.0253	642	.01874	.00194	.00222	33.00	2.79	.0303	1.97	.057	1.61	.082	1.39	.109	1.245	.136	1.14	.162	1.09	.188	.988	.22	.930	.24	.885	.27	.841	.29	.805	.32	.774	.35	.746	.37	.720	.40	.697	.43	.677	.45	.658	.48	.640	.51	.624	.50
	23	.025	625	.0193	.00189		33.38	2.73	.03	1.96	.056	1.57	.082	1.367	.108	1.218	.134	1.11	.160	1.03	.187	.966	.21	.910	.24	.865	.27	.823	.29	.788	.32	.757	.34	.729	.37	.705	.40	.682	.42	.662	.45	.644	.47	.627	.50	.610	.58
23		.0226	509	.02365	.00154	.00178	36.23	2.37	.0270	1.67	.052	1.365	.076	1.184	.100	1.057	.124	.968	.148	.897	.172	.839	.20	.790	.22	.752	.24	.714	.27	.683	.29	.657	.32	.633	.34	.612	.36	.592	.39	.575	.41	.559	.44	.543	.46	.530	.48
	24	.022	484	.0249	.00146		37.04	2.29	.027	1.616	.051	1.320	.074	1.142	.098	1.022	.121	.935	.144	.866	.168	.810	.19	.763	.21	.726	.24	.690	.26	.661	.29	.635	.31	.612	.33	.592	.36	.572	.38	.555	.40	.540	.43	.526	.45	.512	.47
24		.0201	404	.0298	.00122	.00140	39.84	2.01	.0251	1.420	.047	1.157	.069	1.005	.091	.898	.113	.820	.134	.760	.156	.712	.178	.670	.20	.637	.22	.606	.24	.580	.27	.558	.29	.537	.31	.518	.33	.502	.35	.488	.38	.474	.40	.461	.42	.449	.44
	25	.020	400	.0301	.00121		40.00	2.00	.025	1.412	.047	1.152	.069	1.000	.090	.894	.112	.816	.133	.757	.155	.708	.177	.666	.199	.634	.22	.603	.24	.577	.26	.555	.29	.535	.31	.516	.33	.500	.35	.485	.37	.472	.39	.459	.42	.447	.44
	26	.018	324	.0372	.000983		44.44	1.705	.0225	1.203	.042	.984	.062	.852	.081	.762	.101	.696	.120	.645	.140	.603	.160	.568	.179	.540	.198	.514	.22	.492	.24	.473	.26	.456	.28	.440	.30	.426	.32	.413	.34	.402	.35	.392	.38	.381	.40
25		.0179	320	.0377	.000971	.00110	44.64	1.69	.0224	1.193	.042	.975	.062	.845	.081	.755	.101	.690	.120	.640	.139	.598	.159	.563	.178	.536	.197	.510	.22	.487	.24	.468	.26	.452	.28	.437	.30	.422	.32	.410	.33	.399	.35	.388	.37	.378	.39
	27	.016	256	.0472	.000774		48.78	1.444	.0205	1.024	.039	.834	.055	.722	.073	.645	.092	.590	.110	.547	.128	.513	.145	.481	.163	.458	.181	.435	.199	.417	.21	.400	.23	.386	.25	.373	.27	.361	.29	.350	.31	.341	.32	.331	.34	.323	.36
26		.0159	254	.0475	.000771	.000858	49.02	1.436	.0204	1.014	.038	.828	.055	.718	.073	.642	.092	.587	.109	.543	.127	.508	.145	.479	.162	.455	.180	.433	.198	.414	.21	.398	.23	.384	.25	.371	.27	.359	.29	.348	.30	.339	.32	.329	.34	.321	.36
27		.0142	201	.0600	.000608	.000692	53.48	1.223	.0187	.865	.035	.707	.051	.611	.068	.547	.084	.499	.100	.463	.116	.433	.133	.408	.149	.388	.165	.370	.181	.353	.198	.339	.21	.327	.23	.316	.24	.306	.26	.297	.28	.289	.30	.281	.31	.274	.33
	28	.014	196	.0615	.000593		54.05	1.201	.0185	.849	.035	.693	.051	.601	.067	.538	.083	.490	.099	.455	.115	.425	.131	.400	.147	.382	.163	.362	.179	.346	.196	.333	.21	.321	.23	.311	.24	.300	.26	.291	.28	.283	.29	.275	.31	.268	.32
	29	.013	169	.0714	.000513		57.14	1.085	.0175	.767	.033	.626	.048	.542	.063	.485	.079	.443	.094	.411	.109	.384	.124	.362	.139	.344	.154	.327	.170	.313	.185	.301	.20	.290	.22	.280	.23	.271	.25	.263	.26	.256	.28	.249	.29	.243	.31
28		.0126	159.8	.0755	.000482	.000552	58.48	1.043	.0171	.737	.032	.602	.047	.521	.062	.468	.077	.427	.092	.394	.106	.368	.121	.348	.136	.331	.151	.314	.166	.301	.181	.289	.196	.279	.21	.270	.23	.261	.24	.253	.26	.244	.27	.239	.28	.233	.30
	30	.012	144	.0837	.000435		60.61	.973	.0165	.687	.031	.535	.045	.486	.060	.435	.074	.397	.088	.364	.103	.344	.117	.324	.131	.308	.146	.294	.160	.281	.174	.270	.189	.260	.20	.249	.22	.243	.23	.236	.25	.230	.26	.223	.28	.218	.29
29		.0113	126.7	.0952	.000385	.000439	63.29	.893	.0158	.631	.030	.515	.043	.446	.057	.399	.071	.364	.085	.338	.098	.316	.112	.298	.126	.288	.139	.269	.153	.258	.167	.248	.181	.239	.195	.231	.21	.223	.22	.216	.24	.211	.25	.205	.26	.200	.28
30		.01003	100.5	.1200	.000303	.000356	68.97	.762	.0145	.538	.027	.439	.040	.381	.052	.340	.065	.311	.078	.288	.090	.270	.103	.254	.115	.242	.128	.230	.141	.220	.153	.211	.166	.204	.179	.196	.191	.190	.20	.185	.22	.180	.23	.175	.24	.170	.25

Gauge		Diam. Bare Inches	Circular Mils	Ohms per Foot at 60°C.	Lbs. per Foot		Turns per Linear Inch	Layers																																							
BBS	Bir.				Bare	Covered		1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		19		20	
								Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth	Amp	Depth
	2	.284	80656	.0001495	.244		3.36	97.8	.298	69.1	.558	56.3	.819	48.9	1.075	43.7	1.334	39.9	1.59	37.0	1.85	34.6	2.11	32.9	2.37	31.0	2.63	29.5	2.89	28.2	3.15	27.1	3.41	26.1	3.67	25.2	3.93	24.4	4.18	23.7	4.45	23.1	4.71	22.4	4.97	21.9	5.23
	3	.259	67081	.000180	.203		3.66	86.4	.273	60.3	.512	49.2	.750	42.7	.985	38.1	1.222	34.8	1.46	32.3	1.70	30.2	1.93	28.5	2.17	27.1	2.41	25.7	2.65	24.6	2.89	23.7	3.13	22.8	3.36	22.0	3.60	21.3	3.84	20.7	4.07	20.1	4.32	19.6	4.55	19.1	4.79
2	4	.2576	66373	.000182	.201		3.68	84.6	.2716	59.8	.508	48.8	.747	42.3	.980	37.7	1.216	34.5	1.45	32.0	1.69	29.9	1.92	28.2	2.16	26.8	2.40	25.5	2.64	24.4	2.87	23.5	3.11	22.6	3.34	21.8	3.58	21.1	3.82	20.5	4.05	19.9	4.29	19.4	4.52	18.9	4.76
	4	.238	56644	.000213	.172		3.97	75.4	.252	53.3	.472	43.5	.692	37.7	.910	33.6	1.128	30.8	1.35	28.5	1.57	26.7	1.79	25.1	2.00	23.9	2.21	22.7	2.44	21.7	2.66	20.9	2.89	20.1	3.10	19.5	3.32	18.8	3.52	18.3	3.76	17.8	3.98	17.3	4.20	16.8	4.42
3		.2294	52634	.000229	.159		4.11	71.5	.2434	50.5	.456	41.2	.668	35.7	.878	31.9	1.090	29.2	1.30	27.0	1.51	25.3	1.72	23.8	1.93	22.7	2.15	21.5	2.36	20.6	2.57	19.8	2.78	19.1	2.99	18.5	3.21	17.9	3.42	17.3	3.63	16.8	3.84	16.4	4.06	16.0	4.27
	5	.22	48400	.000249	.146		4.27	67.2	.234	47.5	.438	38.7	.642	33.6	.845	30.0	1.048	27.4	1.25	25.4	1.45	23.8	1.66	22.4	1.86	21.3	2.07	20.2	2.27	19.4	2.48	18.6	2.68	17.9	2.88	17.3	3.08	16.8	3.29	16.3	3.49	15.8	3.69	15.4	3.90	15.0	4.10
4		.2043	41743	.000289	.126	.159	4.58	60.3	.2183	42.6	.409	34.8	.599	30.1	.788	26.9	.980	24.6	1.17	22.8	1.36	21.3	1.55	20.1	1.73	19.1	1.93	18.2	2.12	17.4	2.31	16.7	2.50	16.1	2.69	15.6	2.88	15.1	3.07	14.8	3.26	14.2	3.45	13.8	3.64	13.5	3.84
	6	.203	41209	.000292	.125		4.61	59.8	.217	42.3	.407	34.5	.596	29.9	.784	26.7	.974	24.4	1.16	22.6	1.35	21.1	1.54	19.9	1.72	18.9	1.92	18.0	2.10	17.3	2.30	16.6	2.48	16.0	2.68	15.4	2.86	14.9	3.05	14.5	3.24	14.1	3.43	13.7	3.62	13.4	3.80
5		.1819	33102	.000365	.100	.122	5.10	50.8	.196	35.9	.367	29.3	.538	25.4	.708	22.7	.880	20.7	1.05	19.2	1.22	18.0	1.39	16.9	1.56	16.1	1.73	15.3	1.90	14.7	2.07	14.1	2.24	13.6	2.41	13.1	2.58	12.7	2.75	12.3	2.92	12.0	3.10	11.6	3.26	11.4	3.44
	7	.18	32400	.0002725	.0979		5.16	50.0	.194	35.3	.364	28.8	.532	25.0	.701	22.3	.871	20.4	1.037	18.9	1.20	17.7	1.37	16.7	1.54	15.8	1.71	15.1	1.88	14.4	2.05	13.8	2.22	13.3	2.39	12.9	2.56	12.5	2.73	12.1	2.90	11.8	3.06	11.5	3.23	11.2	3.40
	8	.165	27225	.000443	.0825		5.59	44.1	.179	31.1	.336	25.4	.491	22.0	.647	19.7	.804	18.0	.958	16.6	1.11	15.6	1.27	14.7	1.42	13.9	1.58	13.3	1.74	12.7	1.89	12.2	2.05	11.7	2.20	11.4	2.36	11.0	2.52	10.7	2.67	10.4	2.82	10.1	2.98	9.85	3.14
6		.162	26251	.000459	.0794	.0942	5.68	42.9	.176	30.3	.330	24.7	.483	21.4	.636	19.1	.791	17.5	.942	16.2	1.09	15.2	1.23	14.3	1.40	13.6	1.55	12.9	1.71	12.4	1.86	11.9	1.99	11.5	2.17	11.1	2.29	10.7	2.47	10.4	2.60	10.1	2.75	9.85	2.93	9.61	3.09
	9	.148	21904	.000551	.0663		6.17	37.6	.162	26.5	.304	21.6	.445	18.8	.585	16.8	.727	15.3	.867	14.2	1.007	13.3	1.15	12.5	1.29	11.9	1.43	11.3	1.57	10.8	1.71	10.4	1.85	10.0	1.99	9.72	2.14	9.40	2.28	9.12	2.42	8.49	2.56	8.62	2.70	8.41	2.84
7		.1443	20817	.0005795	.0628	.0796	6.32	36.2	.1583	25.6	.297	20.8	.435	18.1	.572	16.1	.712	14.7	.847	13.7	.985	12.8	1.12	12.1	1.26	11.5	1.40	10.9	1.53	10.4	1.67	10.1	1.81	9.68	1.95	9.35	2.09	9.05	2.22	8.78	2.36	8.18	2.50	8.30	2.64	8.10	2.78
	10	.134	17956	.000672	.0544		6.76	32.5	.148	23.0	.277	18.7	.403	16.2	.535	14.5	.665	13.2	.792	12.3	.922	11.5	1.05	10.8	1.18	10.3	1.31	9.80	1.43	9.38	1.56	9.02	1.69	8.69	1.82	8.39	1.95	8.12	2.08	7.88	2.21	7.34	2.34	7.46	2.46	7.27	2.59
8		.1285	16510	.000731	.0501	.0617	7.02	30.6	.1425	21.6	.267	17.6	.391	15.3	.515	13.6	.640	12.5	.762	11.5	.887	10.8	1.010	10.2	1.13	9.70	1.26	9.24	1.38	8.83	1.51	8.49	1.63	8.18	1.75	7.91	1.88	7.65	2.00	7.43	2.12	6.91	2.25	7.02	2.38	6.84	2.50
	11	.12	14400	.000838	.0436		7.46	27.7	.134	19.6	.251	15.9	.368	13.8	.484	12.3	.602	11.3	.717	10.5	.834	9.80	.950	9.23	1.06	8.78	1.18	8.36	1.29	7.99	1.42	7.68	1.53	7.41	1.65	7.15	1.76	6.92	1.88	6.72	1.98	6.26	2.12	6.35	2.23	6.20	2.35
9		.1144	13094	.000922	.0393	.0505	7.79	25.7	.1284	18.1	.241	14.8	.352	12.8	.463	11.5	.577	10.5	.687	9.71	.800	9.10	.911	8.57	1.02	8.14	1.13	7.75	1.24	7.42	1.36	7.13	1.47	6.87	1.58	6.63	1.69	6.42	1.80	6.23	1.91	5.80	2.03	5.89	2.14	5.75	2.25
	12	.109	11881	.001015	.0359		8.13	24.2	.123																																						
10		.1019	10382	.001161	.0314		8.63	21.9	.1159																																						
	13	.095	9025	.001336	.0273		9.17	19.8	.109																																						
11		.0907	8234	.001465	.0250		9.55	18.5	.1047																																						
	14	.083	6889	.00175	.0208		10.75	15.97	.093																																						
12		.0808	6530	.001845	.0198		11.01	15.36	.0908																																						
13	15	.072	5184	.002325	.0157		12.20	13.02	.082																																						
	16	.065	4225	.00286	.0128		13.33	11.22	.075																																						
14		.0641	4107	.002935	.0124		13.50	11.00	.0741																																						
	17	.058	3364	.00358	.0102		14.71	9.55	.068																																						
15		.0571	3257	.00370	.00986		14.90	9.33	.0671																																						
16		.0508	2583	.004665	.00783		16.45	7.92	.0608																																						
	18	.049	2401	.005025	.00726		16.95	7.50	.059																																						
17		.0453	2048	.00589	.00620		18.08	6.72	.0553																																						
	19	.042	1764	.00684	.00536		19.23	6.04	.052																																						
18		.0403	1624	.00742	.00493		19.88	5.70	.0503																																						
19		.0359	1288	.00935	.00389		21.79	4.85	.0459																																						
	20	.035	1225	.00983	.00370		22.22	4.69	.045																																						
20	21	.032	1024	.0118	.00310		23.81	4.14	.042																																						
21		.0285	810	.0149	.00246		25.97	3.52	.0385																																						
	22	.028	784	.01535	.00237		26.31	3.45	.038																																						
22		.0253	642	.01874	.00194		28.33	3.01	.0353																																						
	23	.025	625	.0193	.00189		28.57	2.95	.035																																						
23		.0226	509	.02365	.00154		30.68	2.57	.0326																																						
	24	.022	484	.0249	.00146		31.25	2.49	.032																																						
24		.0201	404	.0295	.00122		33.22	2.20	.0301																																						
	25	.020	400	.0301	.00121		33.33	2.19	.03																																						
	26	.018	324	.0372	.000988		37.04	1.87	.027																																						
25		.0179	320	.0377	.000971		37.18	1.85	.0269																																						
	27	.016	256	.0472	.000774		40.00	1.594	.025																																						
26		.0159	254	.0475	.000771		40.16	1.558	.0249																																						
27		.0142	201	.0606	.000608		43.10	1.362	.0232																																						
	28	.014	196	.0615	.000593		43.48	1.340	.023																																						
	29	.013	169	.0714	.000513		45.46	1.216	.022																																						
28		.0126	159.8	.0755	.000482		46.30	1.172	.0216																																						
	30	.012	144	.0837	.000435		47.62	1.097	.021																																						
29		.0113	126.7	.0952	.000385		49.26	1.012	.0203																																						
30		.01002	100.5	.1200	.000303		52.63	.872	.019																																						

TABLE III.

Gauge		Diam. Bare Inches	Circular Mils	Ohms per Foot at 60°C.	Lbs. per Foot		Turns per Linear Inch	Layers:															
BBS	Bir.				Bare	Covered		1		2		3		4		5		6		7		8	
								Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth	Amp.	Depth
	4	.238	56644	.000213	.172		3.97	113.0	.252	79.9	.472	65.2	.692	56.0	.910								
3		.2294	52634	.000229	.159		4.11	107.2	.2434	75.8	.456	61.8	.668	53.6	.878								
	5	.22	48400	.000249	.146		4.27	100.8	.234	71.3	.438	58.2	.642	50.4	.845								
4		.2043	41743	.000289	.126	.159	4.58	90.5	.2183	63.9	.409	52.2	.599	45.2	.788	40.4	.980						
	6	.203	41209	.000292	.125		4.61	89.8	.217	63.5	.407	51.8	.596	44.9	.784	40.2	.974						
5		.1819	33102	.000365	.100	.122	5.10	76.3	.196	53.9	.367	44.0	.538	38.1	.708	34.1	.880						
	7	.18	32400	.0002725	.0979		5.16	75.0	.194	53.0	.364	43.2	.532	37.5	.701	33.5	.871	30.6	1.037				
	8	.165	27225	.000443	.0825		5.59	66.2	.179	46.8	.336	38.2	.491	33.1	.647	29.6	.804	27.0	.958				
6		.162	26251	.000459	.0794	.0942	5.68	64.5	.176	45.6	.330	37.2	.483	32.2	.636	28.8	.791	26.3	.942				
	9	.148	21904	.000551	.0663		6.17	56.4	.162	39.8	.304	32.5	.445	28.2	.585	25.2	.727	23.0	.867	21.3	1.007		
7		.1443	20817	.0005795	.0628	.0796	6.32	54.3	.1583	38.4	.297	31.3	.435	27.1	.572	24.3	.712	22.2	.847	20.5	.985		
	10	.134	17956	.000672	.0544		6.76	48.8	.148	34.5	.277	28.1	.403	24.4	.535	21.8	.665	19.9	.792	18.5	.922		
8		.1285	16510	.000731	.0501	.0617	7.02	45.9	.1425	32.4	.267	26.4	.391	22.9	.515	20.5	.640	18.7	.762	17.3	.887	16.2	1.010
	11	.12	14400	.000838	.0436		7.46	41.6	.134	29.4	.251	24.0	.368	20.8	.484	18.6	.602	17.0	.717	15.7	.834	14.7	.950
9		.1144	13094	.000922	.0393	.0505	7.79	38.6	.1284	27.3	.241	22.2	.352	19.3	.463	17.2	.577	15.7	.687	14.6	.800	13.6	.911
	12	.109	11881	.001015	.0359		8.13	36.3	.123	25.6	.230	20.9	.338	18.1	.444	16.2	.552	14.8	.658	13.7	.766	12.8	.873
10		.1019	10382	.001161	.0314		8.63	32.9	.1159	23.2	.217	19.0	.318	16.4	.418	14.7	.520	13.4	.620	12.4	.721	11.6	.822
	13	.095	9025	.001336	.0273		9.17	29.7	.109	21.0	.204	17.1	.299	14.8	.394	13.3	.489	12.1	.583	11.2	.678	10.4	.773
11		.0907	8234	.001465	.0250		9.55	27.8	.1047	19.6	.196	16.0	.287	13.9	.378	12.4	.470	11.3	.560	10.5	.652	9.84	.743
	14	.083	6889	.00175	.0208		10.75	24.0	.093	16.9	.174	13.8	.255	12.0	.336	10.7	.417	9.80	.498	9.07	.578	8.49	.660
12		.0808	6530	.001845	.0198		11.01	23.0	.0908	16.2	.170	13.2	.249	11.5	.328	10.3	.408	9.39	.486	8.69	.565	8.14	.645
13	15	.072	5184	.002325	.0157		12.20	19.55	.082	13.8	.154	11.3	.225	9.77	.296	8.73	.368	7.98	.439	7.39	.510	6.92	.582
	16	.065	4225	.00286	.0128		13.33	16.83	.075	11.9	.140	9.71	.206	8.41	.271	7.53	.336	6.87	.402	6.37	.467	5.96	.532
14		.0641	4107	.002935	.0124		13.50	16.50	.0741	11.65	.139	9.52	.203	8.25	.268	7.37	.332	6.74	.396	6.24	.461	5.84	.525
	17	.058	3364	.00358	.0102		14.71	14.32	.068	10.11	.127	8.28	.186	7.16	.246	6.40	.305	5.85	.364	5.42	.423	5.07	.482
15		.0571	3257	.00370	.00986		14.90	14.00	.0671	9.90	.126	8.08	.184	7.00	.242	6.26	.301	5.72	.359	5.29	.417	4.96	.476
16		.0508	2583	.004665	.00783		16.45	11.88	.0608	8.39	.114	6.85	.167	5.94	.220	5.31	.273	4.85	.326	4.49	.378	4.20	.432
	18	.049	2401	.005025	.00728		16.95	11.25	.059	7.95	.110	6.48	.162	5.62	.213	5.03	.265	4.59	.316	4.25	.367	3.98	.418
17		.0453	2048	.00589	.00620		18.08	10.08	.0553	7.13	.104	5.82	.153	5.04	.200	4.50	.248	4.11	.296	3.81	.344	3.57	.392
	19	.042	1764	.00684	.00536		19.23	9.07	.052	6.41	.097	5.23	.143	4.53	.188	4.05	.233	3.70	.278	3.43	.323	3.21	.369
18		.0403	1624	.00742	.00493		19.88	8.56	.0503	6.05	.094	4.93	.138	4.28	.182	3.82	.226	3.49	.269	3.24	.313	3.03	.357
19		.0359	1288	.00935	.00389		21.79	7.28	.0459	5.15	.086	4.20	.126	3.64	.166	3.25	.206	2.97	.246	2.75	.286	2.58	.326
	20	.035	1225	.00983	.00370		22.22	7.05	.045	4.98	.084	4.07	.123	3.52	.162	3.15	.202	2.88	.241	2.66	.280	2.49	.319
20	21	.032	1024	.0118	.00310		23.81	6.22	.042	4.40	.079	3.58	.115	3.11	.152	2.78	.188	2.54	.225	2.35	.261	2.20	.298
21		.0285	810	.0149	.00246		25.97	5.28	.0385	3.73	.072	3.04	.106	2.64	.139	2.36	.173	2.16	.206	2.00	.240	1.87	.273
	22	.028	784	.01535	.00237		26.31	5.18	.038	3.66	.071	2.98	.104	2.59	.137	2.32	.170	2.12	.203	1.96	.236	1.83	.269
22		.0253	642	.01874	.00194		28.33	4.52	.0353	3.19	.066	2.61	.097	2.26	.127	2.02	.158	1.84	.189	1.71	.220	1.60	.250
	23	.025	625	.0193	.00189		28.57	4.43	.035	3.13	.065	2.55	.096	2.21	.126	1.98	.157	1.81	.187	1.67	.218	1.57	.248
23		.0226	509	.02365	.00154		30.68	3.86	.0326	2.73	.061	2.22	.089	1.93	.118	1.72	.146	1.57	.174	1.46	.203	1.36	.231
	24	.022	484	.0249	.00146		31.25	3.74	.032	2.64	.060	2.16	.088	1.87	.115	1.67	.143	1.52	.171	1.41	.199	1.32	.227
24		.0201	404	.0298	.00122		33.22	3.30	.0301	2.33	.056	1.90	.083	1.65	.109	1.47	.135	1.35	.161	1.25	.187	1.17	.214

TABLE I.

TABLE I.—PERMISSIBLE AMPERAGE AND PERMISSIBLE DEPTH OF WINDING FOR ARMATURES WITH DOUBLE COTTON COVERED WIRE.

TABLE III.—PERMISSIBLE AMPERAGE AND PERMISSIBLE DEPTH OF WINDING FOR MAGNETS WITH DOUBLE COTTON COVERED WIRE.

except where large sizes are used, in which case Table III will be consulted, that being calculated for *double* cotton covered wire, and including only the large sizes.

The American Electrical Works standard insulation has been allowed, viz., .007 inch on No. 0 to No. 11 B. & S.; .005 inch on No. 12 to No. 24; and .0045 inch on No. 25 to No. 31 single; twice these values for insulation of double covered wires. Fifteen per cent. is allowed for imbedding of the wires.

The standard of resistance employed is that recommended by the committee of the American Institute of Electrical Engineers, which is 9.612 ohms per mil-foot at 0°. The running temperature of tables is taken at 25° + 35° = 60° C. The column giving the depth for one layer is, of course, the diameter over insulation.

The formula used in calculating the tables is,

$$C = \sqrt{\frac{12 \times W}{\frac{\omega_{mf}}{M} \times T \times L}}$$

where $C =$ current.
$W =$ emissivity in watts per square inch.
$\omega_{mf} =$ ohms per mil-foot.
$M =$ circular mils.
$T =$ turns per linear inch.
$L =$ number of layers in depth.

If great precision is sought in using the tables, it will be necessary to correct the figures showing permissible amperes for curvature of winding, by multiplying them by the co-efficient $k = \sqrt{\frac{2\,\rho}{\rho + \rho'}}$, where ρ and ρ' are the radius of surface of winding and the radius of core, respectively.

For ratios of $\frac{\rho}{\rho'} =$ 1.5, 1.4, 1.3, 1.2, 1.1, 1.05,
$k =$ 1.095, 1.08, 1.06, 1.04 1.02, 1.01.

But it is well enough to neglect the error, as it is on the safe side.

In some cases, for example, where armatures or magnet coils are cased in and circulation is very poor, it may be desirable to use a lesser rate of emission. Thus for a rate per square inch of

	.2	.3	.5	.6	.7	.8	Watt.
Multiply column of amperes by	—	—	.744	.816	.882	.942	in Table I.
	.707	.866	—	—	—	—	in Tables I. and II.

ON THE EXACT ADJUSTMENT OF STANDARDS OF RESISTANCE AND THE DETERMINATION OF TEMPERATURE COEFFICIENTS.—I.

BY

Elmer G Willyoung

As a student and as a practical man to whom the work came as a matter of routine and necessity the writer has made considerable of a study for the last few years of the various methods of exactly adjusting single standards of resistance and of determining the temperature coefficients of such standards and of alloys in general. All the various methods have had careful trial, including those well known as well as those unknown to the profession. The writer has gone to considerable trouble to ascertain the methods used in the leading foreign laboratories, both commercial and scientific, and has diligently searched the foreign periodicals for many years back in quest of information with the result of obtaining many interesting and valuable suggestions. In a paper read before the Franklin Institute[1] somewhat over a year ago the writer briefly referred to some of the best known methods, their advantages and disadvantages, and concluded by expressing his decided preference for the "Carey-Foster" method of making very exact measurements; a piece of apparatus was then exhibited as being highly suitable for this kind of work and some of its capabilities were referred to. Since that time the apparatus and method have been in continual daily use in commercial work and much additional knowledge has been gained; although some defects in the apparatus have manifested themselves, still our confidence in its convenience and accuracy have been strengthened. In the use of the apparatus we have, I think, at one time or another been obliged to note every weak point in its theory or construction and to provide such temporary means as might be obtainable for getting around difficulties as they arose. On a basis of the experience thus obtained I have recently designed and built an improved form of this apparatus which is in every way greatly superior to the apparatus I then showed and which I believe, from reports which I have received of the apparatus used at the leading laboratories of the world for this same purpose, is capable of giving closer comparisons and of being used to obtain the value of a single standard to a higher degree of accuracy than any other arrangement of apparatus yet known. At the time of the reading of the paper above referred to I expressed myself as believing the apparatus to be capable of giving results correct to certainly within $\frac{1}{100}$ per cent. With the improved apparatus which I shall describe, in the hands of a skillful observer, I consider it entirely possible to determine the value of one coil in terms of another to an accuracy of $\frac{1}{500}$ per cent., and even greater.

The theory of the Carey-Foster method may be found fairly well worked out in a number of works[2]; it is as follows: Let Fig. 1 represent, diagrammatically, the orthodox slide wire bridge in which X is the unknown resistance (nearly equal to the coil S) to be accurately measured in terms of S; R$_1$ and R$_2$ are resistances roughly equal to one another and to S. The balance reading will then fall near the centre of the bridge. The heavy copper end straps are of resistances which may be designated by r_1 and r_6, the resistance of the other connectors by r_2, r_3, r_4 and r_5, as shown.

When a balance is obtained we have

$$\frac{R_1 + r_2 + r_3}{R_2 + r_5 + r_6} = \frac{X + r_1 + x_1\,\rho}{S + r_6 + (L - x_1)\,\rho} \qquad (1)$$

x_1 being the reading,
L " " whole length of the bridge wire,
ρ " " resistance of a single division of the bridge wire.

Reversing the position of X and S and balancing again we have:

$$\frac{R_1 + r_2 + r_3}{R_2 + r_4 + r_5} = \frac{S + r_1 + x_2\,\rho}{X + r_6 + (L - x_2)\,\rho} \qquad (2)$$

From (1) we have

$$\frac{R_1 + r_2 + r_3}{R_1 + R_2 + r_2 + r_3 + r_4 + r_5} = \frac{X + r_1 + x_1\,\rho}{X + S + 2\,r_1 + L\,\rho} \qquad (3)$$

and from (2)

$$\frac{R_1 + r_2 + r_3}{R_1 + R_2 + r_2 + r_3 + r_4 + r_5} = \frac{S + r_1 + x_2\,\rho}{X + S + 2\,r_1 + L\,\rho} \qquad (4)$$

$$\therefore X + r_1 + x_1\,\rho = S + r_1 + x_2\,\rho \qquad (5)$$

and $S - X = \rho\,(x_1 - x_2)$; or $X = S - \rho\,(x_1 - x_2)$; (6)

so that the unknown, X, differs from the standard, S, by exactly the resistance of the bridge wire over which the slider moves in changing from one position of balance to the other when the coils X and S are interchanged. We also see that the expression is entirely independent of the length of the bridge wire and also of the connecting coppers provided only that these last be symmetrical. We may, therefore, measure as small differences as we please by merely making the resistance of our bridge wire small enough.

---

[1] "Resistance Standards; their manufacture and adjustment." *Journal Franklin Institute*, April, 1892, also THE ELECTRICAL ENGINEER.

[2] See "Elementary Practical Physics," by Stewart & Gee, Vol. II., pp. 158, etc.

The earlier apparatus referred to, and which has been used in the daily routine of Queen & Company's laboratory, is shown in diagram in Fig. 2. This was a piece of apparatus by which the coils x and s of Fig. 1, could be quickly and easily interchanged. The design was first suggested by Prof. H. S. Carhart of Michigan University, in 1887, and the first piece was made by the writer while in attendance at that institution; it is still there and still being used as the "old reliable" for this class of work.

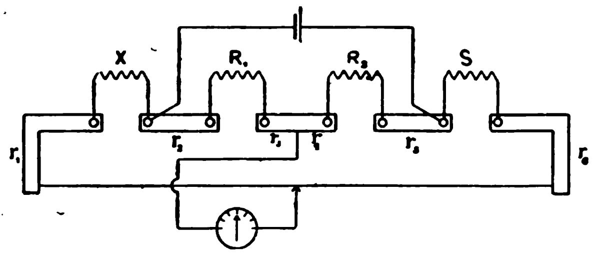

FIG 1.

Upon a suitable insulating base are mounted a number of copper straps and plates as shown; these are so arranged as to place four coils in exactly the same relation to one another as in Fig. 1, the lettering upon the two figures being the same. Coils x and s, have their terminals resting in mercury cups; the coils R_1 and R_2, being practically only extensions of the bridge arms, are simply fastened firmly into the binding posts. The galvanometer and battery circuits are as shown. In the centre of the apparatus are seen two groups of mercury cups, each group forming a square; these groups are connected together, as shown, by the heavy copper rods *c*. By now running around the circuit from the left, clock wise, it will be seen that the order is exactly the same as in Fig. 1. If now we alter the position of the heavy connecting rods *c*, to the position indicated by the dotted lines *d*, the coils x and s will be interchanged as will be readily obvious by again following around the circuit. In practice each pair of connectors is held in a little hard rubber platform so that but two movements are required to effect the change; being held loosely in the platform, they will adjust themselves to the surface of the bottom of the cup and thus make thoroughly good contacts.

Inspection will show that this apparatus is a perfectly symmetrical arrangement, and that, consequently, the connector resistances need not be considered; thus, with the commutator rods, as shown by the heavy lines and passing around the circuit from the bridge, clock wise, we have in circuit on the left, *g*, x and *h*, the other pieces being very obviously pairs; and on the right *f*, s and *e*. Turning the commutator through 90 degrees to the positions indicated by the dotted lines starting from the left, again we have *e*, s and *f*; and from the right *g*, x and *h*. Since $e = h$ and $f = g$ it is the same whether they are on one side or the other, and therefore only the resistances x and s have *really* been interchanged. To use this apparatus, it is only necessary to insert the two slotted terminal straps into one of the gaps of an ordinary slide wire bridge. In the work which we have been doing, we have been using a special form of slide bridge designed by the writer and having three wires, each a meter long, which can be thrown into multiple with one another if desired.

The first design, however, showed in practice a number of defects and sources of inconvenience. The first of these arises when we attempt to obtain the value of the resistances of the bridge wire per unit division. This, of course, might be obtained by connecting the ends of the wire directly to a "Wheatstone's bridge" arrangement and obtaining its resistance by ordinary methods. The resistance however, is necessarily very low as we shall see from the following considerations. Suppose we have a standard ohm and a resistance of platinoid nearly equal to the ohm, whose temperature coefficient we wish to determine exactly. We place the two coils in oil baths with both at, say, 15° C. and obtain a balance; we then carefully raise the temperature of the platinoid to, say, 30° C. and balance again. The difference in terms of resistance of the bridge wire will be the actual increase in resistance of the platinoid. The rise of resistance of platinoid per degree C. is about 0.00023; multiplying this by 15 we have 0.00345 ohm as about the actual increase of resistance due to the raising of the temperature from 15° to 30° C.

Let us suppose also that the value of the coefficient must be obtained to the fifth decimal place, or, in other words, that the resistance .00345 must be measured with a maximum error a trifle less than 0.00008 ohm. With the average slide wire bridge a skilled observer is able to set the slider, it may be assumed, successively, with a error of, say, not less than about $\frac{1}{10}$ mm. Consequently $\frac{1}{10}$ mm. of the wire must measure at least as low as 0.00008 ohm and hence the whole wire, 1,000 mms. long, will measure 10,000 times this, or $\frac{8}{10}$ ohm. To measure even as low a resistance as this even to $\frac{1}{25}$ per cent. is not at all an easy matter by ordinary methods. In practice the resistance of a meter wire should be as much less than the value given above as possible, as a greater length of wire would then be used when x and s were changed; non-uniformity would, consequently, become relatively less important, and errors of setting would bear a smaller ratio to the whole length used. It would also be much better, if possible, to measure the resistance of the bridge wire in terms of the resistance of the standard itself as we would thus eliminate any difference of adjustment between the single standard and any box which we might use for the purpose of measuring the resistance of the bridge wire by ordinary methods. We are, indeed, able to very accurately use this method and apparatus in measuring its own bridge wire. To do this we merely place a heavy short copper strap of negligible resistance in place of x and a resistance, Q, somewhat less than the resistance of the single wire, at the right, Fig. 1. Taking our two balances as before we have from (6)

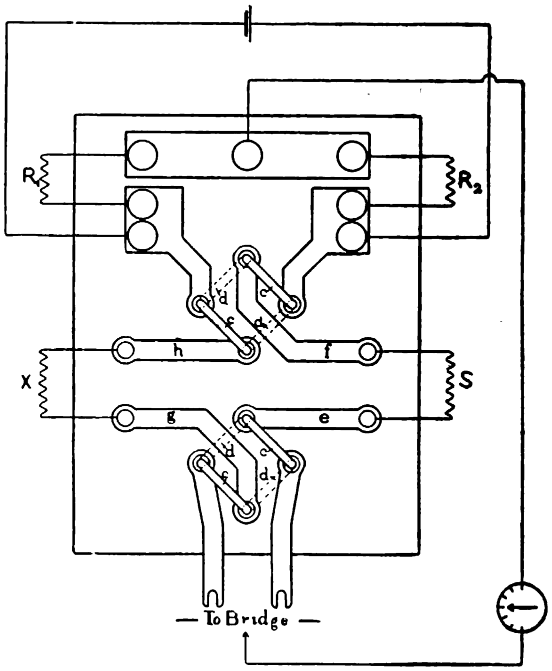

FIG 2.

$$Q - 0 = \rho(X_1 - X_2) \therefore \rho = \frac{Q}{X_1 - X_2} = \frac{Q}{\delta} \quad (8).$$

To find, now, the resistance of Q, place it in multiple with the standard, S, at the right, and again determine the difference, in this case S_2; we shall have

$$\frac{Q\ S}{Q + S} = \rho\ \delta_2 \qquad (9);$$

and, eliminating Q between (8) and (9) we have

$$\rho = S \times \frac{S_1 - S_2}{S_1\ S_2}.$$

Still a third way, which I have used a great deal, is to place a standard 1 and 10 ohm coil in multiple upon one side against a standard ohm coil on the other. In the early form which I have described it was very difficult to accomplish any of this placing in multiple as there was but one pair of mercury cups upon a side; consequently, we were obliged to make an accessory double pair of cups with connectors to hook into the regular standard cups; this introduced another mercury contact, in itself a bad thing, and also an additional copper resistance which disturbed the symmetry of the apparatus, and hence, the rigid accuracy of the preceding equations.

In the improved design of apparatus, shown in Fig. 3, provision has been made for the placing, if desired, of two coils upon each side, and this in a way which does not in the least disturb the original symmetry of the apparatus. In the diagrammatic sketch of this form, Fig. 4, there is shown a 10 and 1 ohm coil in multiple on one side against a 1 ohm on the other side; it will be observed, also, that the cups are so placed that the coils clear one another perfectly and have ample room about them for the necessary oil or water bath. The distance between these cups is $\frac{15}{16}$ inch, the usual distance between terminal coppers of the B. A. form of standards, which distance will, for the sake of uniformity, probably be retained by all instrument makers for a long time to come.

The resistance of the coils R_1 and R_2 disappears in the course of the measurement, as is seen from inspection of the equations (5) and (6). It is hence not necessary that the value of these resistances be known; all that is desired is that they should be approximately of the resistance of the coils under comparison, in order that the balance may fall near the centre of the wire and that their resistance should not change during the progress of the measurement. To insure this latter, it is sufficient to wind the two coils upon the same spool. In the Ann Arbor apparatus these two coils were simply enclosed in a plain, round wooden box. Later on it occurred to me, however, to place them upon a spool mounted upon a little stand having a pair of terminals upon each side fitting into the binding posts at T; the apparatus was thus compacted and made better appearing, and the coils could be more readily removed and others substituted in case standards of a greater or less value were to be compared. In this last design the spool itself is so made as to be removable from the platform instead of the whole platform having to be taken off. The terminals of the platform end in little copper binding posts, T, which receive terminal rods coming from the coils themselves; these coils are wound upon a spool enclosed in a small cylindrical brass case, S, mounted upon a rubber sub-base, P. Each case has engraved upon its top the values of the enclosed resistances as, $\frac{\text{“ 2 ”}}{\text{1 ohms}}$, $\frac{\text{“ 2 ’}}{\text{10 ohms}}$, etc.; if we desire to adjust 10-ohm standards instead of 1-ohm standards we merely unscrew the little milled head screws at the side of T, lift off the spool and replace it by another one, S, of suitable value.

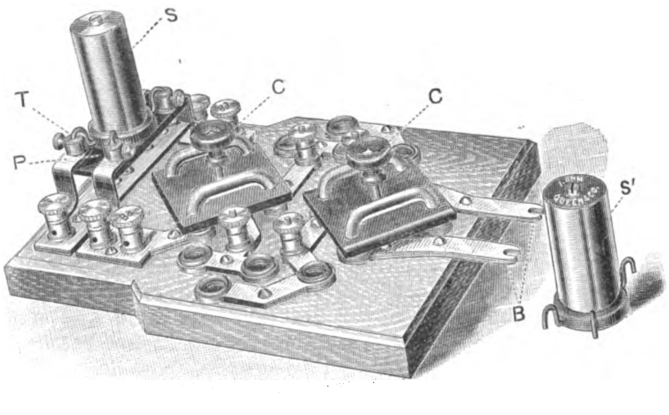

FIG. 3.—APPARATUS FOR COMPARING RESISTANCE STANDARDS.

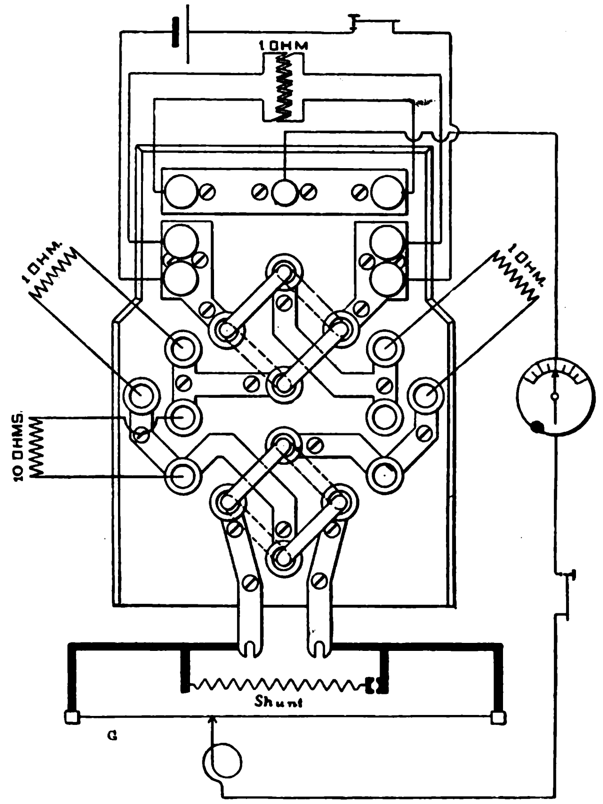

FIG. 4.

Obviously, any form of slide wire bridge may be used with this device. The best results will, however, be obtained by using a form of bridge specially adapted to the peculiar conditions met with. Several things are essential in a wire for use in applying this method. First, the divisions of the scale must be numerous and they must be accurate, since the actual *length* of wire moved over represents the difference in resistance between the two standards; second, the resistance of the wire must be *low*, so that as great a length as possible may be moved over in going from one balance to another; in this way any error of setting becomes, relatively, as small as possible, and errors of graduation are similarly affected; third, thermal currents must be reduced to the smallest minimum in order not to mask the exceedingly small E. M. F.'s representative of the small differences of resistance which we are measuring; fourth, it must be so constructed as to not easily get out of adjustment, and, lastly, it should be convenient to use. This last specification is, of course, a *general* one to be applied to *all* bridge wires.

AN ELECTRICAL ENTERTAINMENT.

AT a recent entertainment for the benefit of the Free Library of Rutland, Vt., Mr. M. J. Francisco devised some novel and very pleasing electrical effects. He showed how electricity could be applied to house-keeping in many ways with a great saving of labor.

THE ROPE DRIVEN ELECTRIC PLANT OF THE RACQUET CLUB, NEW YORK CITY.

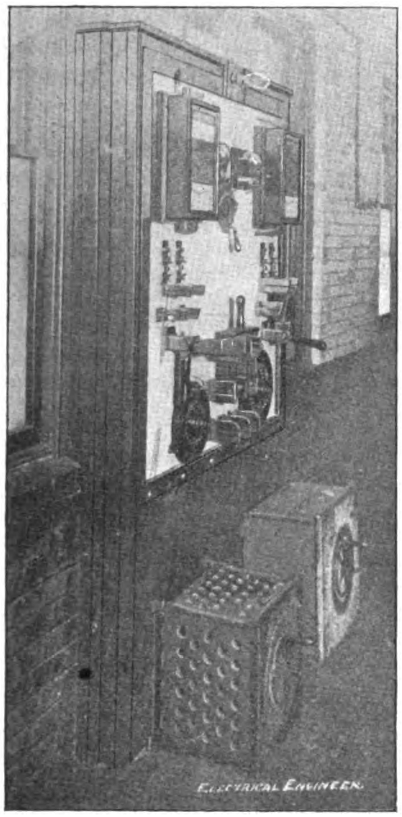

Fig. 3.—Switch Board Racquet Club.

The electric plant of the Racquet and Tennis Club, New York, demonstrates that the day of the so-called "system," at least for isolated plants, is past. Among the various kinds of electrical apparatus used in this plant, there are no two kinds made by any one manufacturing company. The apparatus best suited specially for the conditions was selected, regardless of system or manufacturing company, and the result is a combination of apparatus superior in average of excellence to that manufactured by any one of the manufacturing electric companies.

Here we find Ideal engines, a novel and ingenious endless rope driving gear, especially designed for this plant, Eickemeyer dynamos, Carpenter field rheostats, Weston voltmeters, Edison ampere meters and Ajax switches, an aggregation of superior apparatus, not half of which has ever been placed in combination before.

The problem presented by this case was an unusually difficult one, as the space was extremely limited and the avoidance of all noise and vibration was of the utmost importance. On account of the space at disposal and the noise, belts were out of the question. The space available was a long narrow strip 9 feet by 38 feet, shown in Figs. 1 and 2; and the two engines, two dynamos, the pumps, the heater and the switchboard had to be placed therein, the capacity of the plant being 1,000 16 c. p. lamps. The dynamos and engines could not be directly coupled on account of the narrowness of the space. The contractors were given full scope to secure the result, and devised a novel and ingenious modification of the single endless rope drive to meet the emergencies of the case, with the result that the plant is surprisingly noiseless and free from all vibration. The main peculiarity of this rope drive is that the tension pulley is fixed, and the slack of the rope is taken up by sliding the dynamo back as in ordinary belt practice.

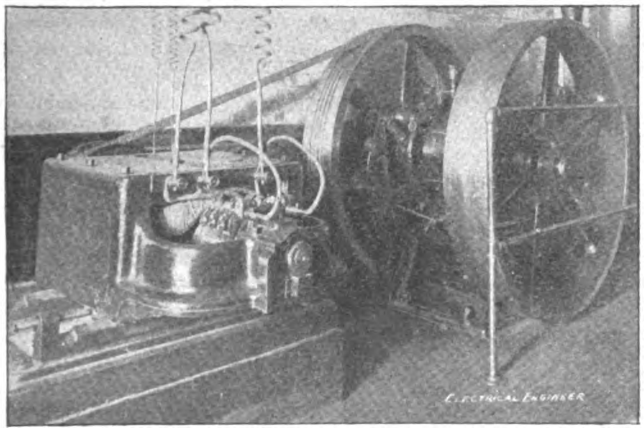

Fig. 1.—Rope Driven Dynamo Plant, Racquet Club, New York.

The limitation of space made the usual field rheostats prohibitory, and the Carpenter enamel rheostat was installed for this purpose for the first time, with very satisfactory results. The comparative spaces occupied by the rheostat of the ordinary type and the enamel rheostat is well shown in Fig. 3.

Prof. Francis B. Crocker, who acted as consulting engineer for this plant, deserves the thanks of the electrical profession for being the first consulting electrical engineer to recognize in a practical manner that, in electrical engineering even more than in other engineering practice, the best results should be obtained by utilizing the apparatus and methods representing the most recent improvements in the art and having the plant installed by engineers such as H. Ward Leonard & Company, the contractors for this,—free and able to take advantage of the best practice of to-day, and even to improve upon such practice should opportunity offer.

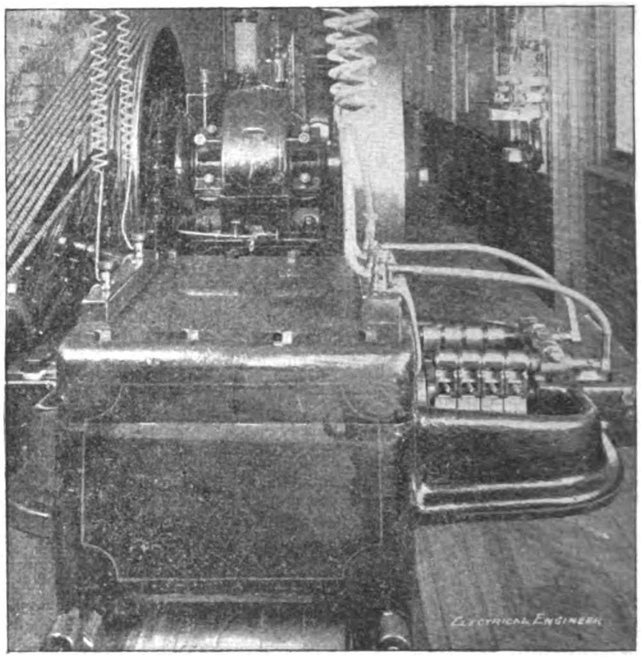

Fig. 2.—Rope Driven Dynamo Plant, Racquet Club, New York.

CIRCULATING BATTERY.

M. Serrin has recently brought out a continuous circulating battery, illustrated in *L'Electricien,* which is a simple sulphate of copper battery with zinc and carbon electrodes, but with a syphon arrangement for keeping up a continuous circulation. Two vessels, from and to which the liquid flows, are reversed every morning. The battery, it is claimed, has a low internal resistance, and is constant and economical.

THE FIRST MARINE LIGHTING PLANT.

An incandescent lighting plant said to be the first turned out of Edison's shops at Menlo Park will probably be on exhibition in the Electricity Building at the World's Fair. It is now used on board the steamer "Columbia," plying between San Francisco and Portland, Ore., where it was placed in Position in May, 1880. It has been in satisfactory operation ever since, with no alterations.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

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The first requisite of an observer is that his mind should be actively awakened to the phenomena of nature with which he is surrounded.—Joseph Henry.

THE LAMP SITUATION.

PROBABLY no one interested in any aspect of the case was surprised by the final outcome of the Edison and Sawyer-Man suit. We print elsewhere an abstract of the conclusion of the argument and the full text of the decision of the appellate court. The injunction granted against the Sawyer-Man Company will, of course, enable the General Electric Company to obtain similar injunctions against any or all other infringers of the second claim of the Edison patent, which is :

> The combination of carbon filaments with a receiver made entirely of glass and conductors passing through the glass and from which receiver the air is exhausted, for the purposes set forth.

The provision in the injunction order permitting application to the Court thereafter for the vacation, suspension or modification of the injunction, upon proof of the complainants' refusal to sell lamps to owners of plants installed before the Circuit Court sustained the patent (July 14, 1891,) will be regarded as some protection against the "unconscionable use" of the patent alleged to be intended by the General Electric Company. The right to attack the injunction in court would, we suppose, exist without this provision; but it is an advantage that this court announces in advance its readiness to entertain the application indicated. The court declined to investigate "upon the present case" the character of the combination forming the General company, for reasons stated fully in the decision.

The General Electric Company is thus put in full possession of all rights pertaining to the patent till its expiration a year or so from now. It remains to be seen just how it will use it, and with what effect upon the industry of electric lighting and upon the fortunes, particularly, of competing manufacturers. It should be, and we hope always will be, an occasion for congratulation, in itself, when a patent is sustained; although there must usually follow real or seeming hardship to somebody. In the present instance the hardship will be great and widespread, should the possession of the Edison patent prove a means by which the General company shall succeed in the purpose, so frequently attributed to it, of crushing out all competition, not merely in lamps, but in dynamos and all other electric lighting apparatus, and building up a control of electric lighting similar to that of telephony by the American Bell Company. We shall not undertake to read the minds of the president and directors of the General Company, nor that of their adviser, the distinguished and brilliant counsellor who brings to their service the experience derived from his connection with the Bell Telephone Company, and should know how to make the most of an adjudicated patent. If they press their legal right to the utmost limit, not only against infringing lamp makers, but, through their relations with lighting companies and the exaction of contracts that would shut such consumers out of the open market in the purchase of dynamos, accessory machinery and supplies,—whether or not such a course would bring them under the laws against the illegal restraint of trade—it would quite certainly enlarge and intensify the feeling of hostility and distrust toward the General Company now so prevalent among all who are in any way connected, directly or indirectly, with electric lighting. Can they afford, especially in view of the small period of life remaining to the Edison patent, to have every man's hand against them when the protection of that patent shall be withdrawn ?

Doubtless many lamp manufacturers, if unable to make terms for licenses, will soon be obliged to discontinue. Such of them as are suitably equipped will probably give their attention to making other apparatus until the expiration of the patent ; after which time a period of general competition in lamp making may be inaugurated. Meantime purchasers and the public are awaiting with interest the arrival upon the market of the non-infringing lamps promised by Mr. Westinghouse to be forthcoming January first.

THE INFLUENCE OF THE AIR ON ELECTRIC DISSIPATION.

THE description in our columns last week of the results obtained by Prof. Bjerknes in his experiments on the dissipation of electrical energy of the Hertz resonator has served to call forth an exceedingly interesting communication from Mr. Nikola Tesla, in which he details a number of facts and phenomena observed by him in his high frequency alternating work. Mr. Tesla, it will be noted, lays great stress on the influence of the air on the rate of electric dissipation with the currents here under consideration owing to its discontinuous nature, while he also explains thereby the observed difference between magnetic and non-magnetic metals as dissipators of electric energy. Mr. Tesla also points out some highly suggestive analogies between the rate of electric dissipation and that of dissipation by heat, fine wires in both cases being shown to have relatively greater powers in this respect. The mechanical action of the "electric sound-waves," observed by Mr. Tesla, is also of a decidedly interesting nature,

A DIFFERENTIAL WATTMETER FOR ALTERNATING CURRENTS.

BY

A. E. Kennelly

THE measurement of the efficiency of transformers is necessarily an important matter, for, setting aside the cost of the power that has to be expended in their excitation, wasteful transformers must, by undue heating, limit to a greater or less degree the output they could be made to yield with better materials or proportions.

The earlier and calorimetric tests of transformers[1] have been latterly almost entirely superseded by electrical wattmeter methods, which have themselves been tried in a variety of forms[2]. These instruments are capable of determining with all desirable precision the loss in transformers that are idle or that are worked on light loads. Although two such instruments, or two measurements with the same instrument, one for the energy absorbed, the other for the delivery, enable the efficiency to be determined at any load, yet when the readings of the instruments are large, they are well known to be less reliable, and the most recent advances have therefore been made in the direction of null methods, which Dr. Sumpner[3], and also Dr. Hopkinson[4] have used with excellent results.

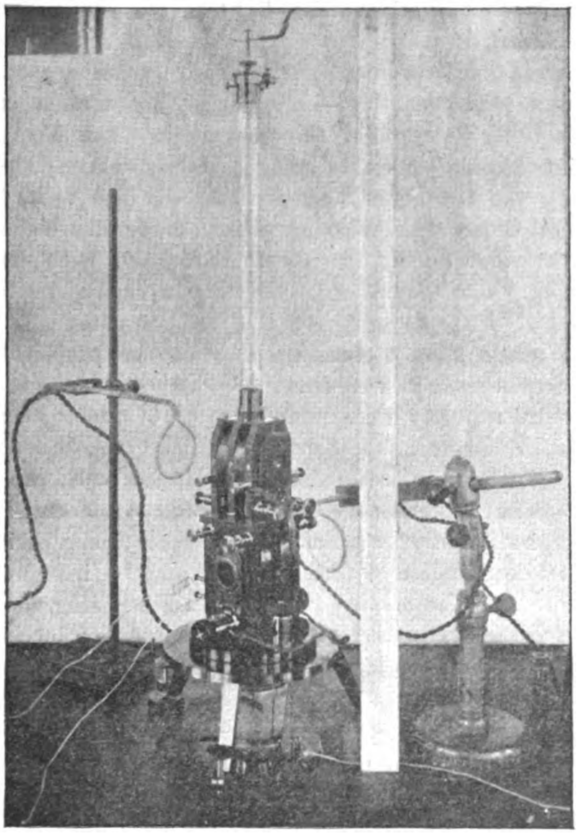

FIG. 1.—DIFFERENTIAL WATTMETER FOR ALTERNATING CURRENTS.

The object of this article is to describe a differential wattmeter that has been constructed and tested for the last nine months at the Edison Laboratory. This instrument is a double electrodynamometer of the Kohlrausch unifilar type and is reproduced from a photograph in the accompanying engraving, Fig. 1. These two dynamometers are arranged as wattmeters with their suspended coils rigidly connected by an aluminum shaft 8 cms. long. The upper wattmeter is in the primary circuit of the transformer to be tested, the lower in the secondary. The intake is therefore measured by the former, and the output by the latter, so that when the sensibilities of the two dynamometers are adjusted to equality, that is to say, when they are balanced differentially, the reading of the torsion head corresponds to the loss of power in the transformer due to all causes combined—hysteresis, c^2r, eddies, and radiation.

Thus assuming that the sensibility of each dynamometer was such that one degree of torsion represented an activity of five watts, and that they were independently inserted in the primary and secondary circuits of a 20 K. W. transformer worked at full load, the upper instrument would indicate, say, 20,750 watts with a torsion of 4,150 degrees, the lower 20,000 watts with a torsion of 4,000 degrees. Such a degree of sensibility would be of course quite impracticable, but mounted in combination with a common suspended system, the resultant torsion would only amount to 150 degrees. An uncertainty of 1 per cent. in the indications of the independent instruments would affect the results to a range of 207.5 + 200 or 407.5 watts. In the differential instrument, 1 per cent deviation at the same load would represent 1.5 watt error.

The framework of the instrument is entirely of hard rubber, supported by a stout brass tripod. To avoid frequent repetitions, we may denote the upper dynamometer's fixed coil by U, its suspended coil by *u*, and the corresponding coils of the lower dynamometer by L, and *l*, respectively.

In a differential instrument of this description, it is, of course, essential that U should have no effect on *l*, and likewise L none on *u*, so that the mutual inductance of these pairs of opposite coils must be negligibly small. This result is mainly accomplished by setting the two dynamometers at right angles in azimuth, but there is a residual mutual inductance, if only from the axial components of the coils which at this short range fail to be represented by simple solenoids. As this residual influence would introduce a very appreciable error at heavy loads, with the sensitive differential adjustment, it is necessary to eliminate it, and this is done by single turn auxiliary coils, set by trial outside the instrument, as shown in the engraving, in such a manner as to possess compensatory mutual inductance between L and *u*, U and *l*, but no appreciable additional inductance between L and *l*, U and *u*. All the leads to the instrument have to be carefully double wound to prevent external electromagnetic influence. There are four windings on L and also four on U, making eight pairs of binding posts in all for fixed coils, with two pairs of smaller binding posts for the connections with the suspended coils.

Coil.	No. of Turns.	No. of Layers.	Wire.	Resistance at 20 ohms C.	Inductance in millihenrys.
U 1	432	8	26 B.W.G.	7.11	5.44
U 2	120	4	22 "	0.934	0 588
U 3	28	2	15 "	0.0388	0.055
U 4	6	1	9 "	0.0028	0.023
L 1	120	4	19 "	0.36	0.389
L 2	28	2	18 "	0.22	0.052
L 3	4	1	strip 0.4" x 0.02"		
L 4	2	1	strip 0.875" x 0.02"		

The control of these eight coils in any combination gives the instrument a very wide range, and it can be used to test any transformer of the ordinary type up to 100 K. W. capacity.

The two small suspended coils are made of hard rubber and are similar. They have each an external diameter of 2.8 cms., internal 0.75, and an interflange of 0.96, wound with 675 turns in 27 layers of No. 33 B.W.G. with a resistance of 20 ohms, and an inductance of 6.6 millihenrys. Each coil weighs about 30 grammes, and the weight of the whole suspended system is about 65 grammes. Four connections have to be permanently maintained with this system, one through the torsion wire, one through the damping vane, and two by single loops of fine copper wire 0.002 inch, (0.005 cm.) passing under the base from opposite sides of the suspension rod of hard rubber to small binding posts. These loops are so flexible that they do not sensibly impair the oscillatory freedom of the system within the small limit of play allowed. The insulation of these fine wires is carefully preserved by carrying them up the suspension rod imbedded with wax in little grooves. This is essential, as 2,000 volts may be active between them. The suspension wire is of copper 32.6 cms. long, and 0.0115 cm. in diameter. Its torsional moment is 18.6 centimetre-dynes per radian of twist, and one complete revolution of the torsion head can be allowed without sensible elastic fatigue. The zero of the instrument is read by mirror, telescope, and scale. A slight directional force is provided by two loops of wire from the vane head to the sides of the damping vessel, which wire loops, maintaining electrical connection between the vane and base terminal, are straddled by small rider weights whose gravitational influence is sufficient to keep the zero definite. The vane itself swings in water covered with a layer of heavy oil, so that the oscillations are almost deadbeat.

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[1] *Journal* of the Institute of Electrical Engineers, London. Vol. XVII., No. 71, Feb. 1888, p. 168, and Vol. XVIII., No. 81, May 1889, p. 608.

[2] Ayrton & Sumpner, *Phil. Mag.*, Aug. 6, 1891.

[3], [4] *The Electrician*, London, July 1, 1892.

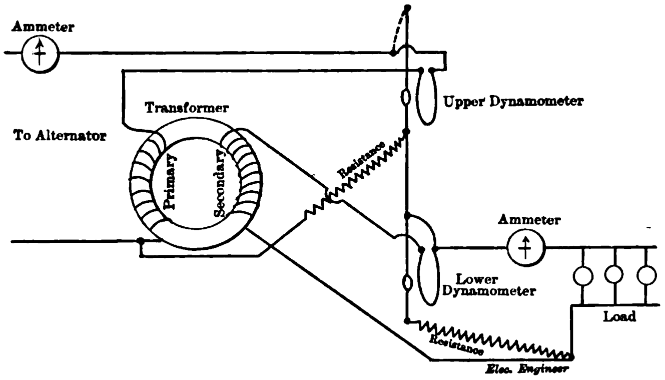


FIG. 2.

The transformer connections are indicated in Fig. 2. The compensation for mutual inductance between L *u* and U *l*, is first completed with each pair by trial. The two dynamometers are then balanced differentially. The fixed coils are connected in series and the suspended coils in parallel with suitable non-inductive resistances in their circuits and these resistances are adjusted until balance is obtained. For 1,000 volts of alternating primary pressure, 20,000 ohms is a good resistance for the primary suspension circuit, and in the secondary whatever may be necessary. For 100-volt secondaries, 4,000 ohms can usually be approximated to, making the $c^2\,r$ loss in this circuit about 2.5 watts. The value of the torsion readings is then found for either dynamometer by trial.

When the connections are made as in Fig. 2, and the secondary coil is open, the torsion needed to restore the zero is due to the upper dynamometer only, and measures the excitation loss. As the load is connected with the secondary, the torsion increases and measures the loss in the transformer plus the two or three watts absorbed in the circuit of *l*. If it is desired to analyze the loss due to hysteresis and eddies at each load, ammeter readings must be taken in both primary and secondary circuits, and in any case voltmeter and ammeter readings are required in the secondary circuit to determine the out-put. From this out-put and the observed loss in the transformer, the efficiency can be immediately deduced. It is easy to show that with such an instrument, the results are not influenced by the shape of the waves of E. M. F. generated by the alternator, and that the error due to lag in the suspended coil circuits is quite negligible when proper non-inductive resistances are employed.

The following is a specimen table of observations on a particular transformer. The calibration was so adjusted that each degree of torsion represented one watt. It will be seen that the loss due to hysteresis and eddies combined is practically constant throughout. In a few instances, tests of transformers whose magnetic leakage has been considerable, have shown an apparent decrease in excitation loss between idleness and full load, but amounting to only three per cent.

In this case the wattmeter was differentially balanced after compensation for mutual inductance and carefully adjusted.

Balance 19,480 ohms in primary suspension circuit.
3,735 " " secondary " "

These resistances were of bare german silver wire, non-inductively wound on insulating grids. The compensation and balance were checked after test.

No. of Obs.	Torsion	Primary current amperes.	*R* ohms.	R_a torsion constant watts.	Energy lost in transfr. (watts).	Load (lamps).	Secondary current amperes.	P. D. at second'ry terminal volts.	Energy in secondary ex. circ't	Primary $c^2\,r$ watts	Secondary $c^2\,r$ watts.	Total $c^2\,r$ loss watts.	Hysteresis and eddies (watts).	Efficiency of transf'rmer.
1	91°	0.1	19,480	1.000	91	..	.....	52.4	....	0.1	...	0.1	90.9	0.
2	91°	0.25			91	3	2.046	52.4	107	0.6	0.1	0.7	90.3	0.54
3	92°	0.3			92	6	4 092	52.3	214	0.9	0.2	1.1	90.9	0.699
4	93°	0.4			93	12	7.818	51.6	404	1.8	0.7	2.5	90.5	0.818
5	95°	0.6			95	18	11.46	51.5	590	3.1	1.4	4.5	90.5	0.861
6	99°	0.79			99	25	15.28	51.0	779	6.8	2.6	9.4	89.6	0.887
7	110°	1.13			110	36	21.32	50.3	1072	14.5	5.0	19.5	90.5	0.907
8	127.5	1.55			127.5	50	28.44	50.0	1422	27.2	8.9	36.1	91.4	0.918
9	91°	0.1			91	..	.....	52.4	....	0.1	...	0.1	90.9	0.

ORNAMENTAL LAMP POSTS IN GERMANY.

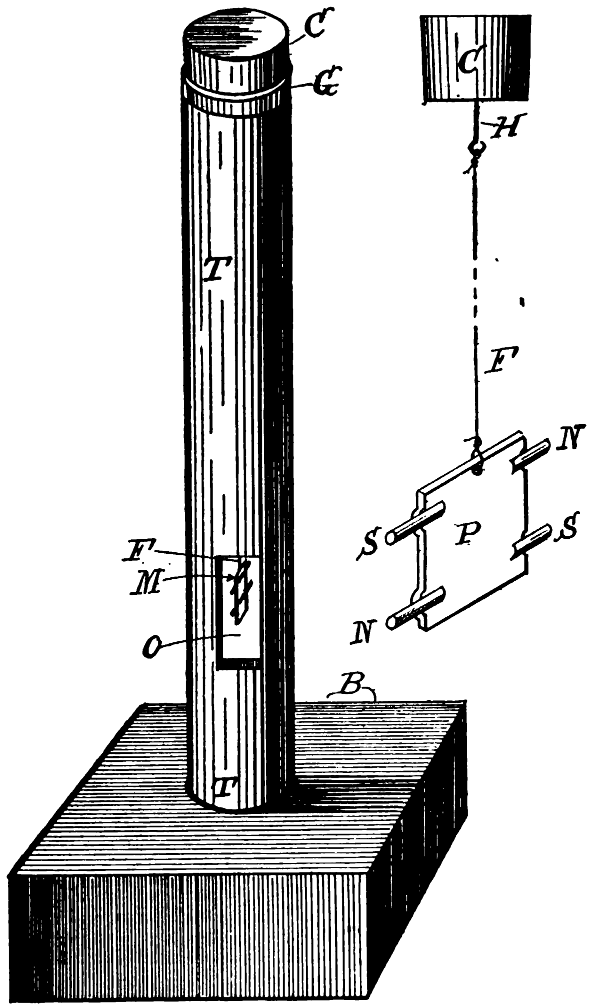
A BERLIN, Germany, reader of THE ELECTRICAL ENGINEER writes: "Your article on the Fifth avenue arc lighting from incandescent circuits interests me. It is the best indication of the new tendency in American cities towards the use of neat and even beautiful electric lamp supports, such as one may see in so many European cities. As this system is referred to by you as new and patentable, it may be of interest to you to know that the same arrangement has been in use in Hamburg about two years. I saw it erected; saw the man trim the lamps frequently; and always admired it as a practical affair. It is in a group of lamps around the Alster. Most of the lamps hang on separate ornamental house arms, or are placed on candelabras; but in this case, at the head of the Neuerwall two were placed on the same pole with two arms similar to that shown in the ENGINEER, and with the rheostat in the base as in all the other Hamburg street lamps. The installation was made by the Hamburg City Electrical Works, under the superintendence of Mr. Von Geisberg."

A SIMPLE MAGNETIC DETECTOR.

BY

James Bowstead Williams M.D.

In the course of a physician's practice he is often called upon to determine whether or not a piece of a needle or tack has become embedded in the body of his patient. If he is consulted immediately after the injury has been received, it is generally a simple matter to locate the metal, and remove it. But if several weeks have elapsed since the real or supposed insertion of the metal, it is a very difficult thing not only to decide whether metal is present in the body, but also to ascertain its location; for it is a well-known fact that a piece of a needle, and sometimes a whole needle will often travel a considerable distance in one of the limbs. The writer was once called in consultation in a case where the history and symptoms strongly indicated that a piece of a carpet-tack had entered the foot of an adult and lodged there some weeks previously. As some kind of magnetic device was indispensable, in order to effect a diagnosis, the writer made the simple but effective detector which is here shown and described. Its use demonstrated the fact that the symptoms were not caused by a piece of iron, and the favorable termination of the case proved that the indications of the detector were correct. The detector consists, essentially, of an astatic combination of magnets suspended by a cocoon fibre in a tube, which will protect the suspended device from the effects of electrical charges and air currents.



SIMPLE MAGNETIC DETECTOR.

The tube T, is a piece of clear glass tubing, the inner and outer surfaces of which are entirely covered with tinfoil, except the two openings, O, through which the movements of the magnets can be seen. The tinfoil can be secured to the glass by mucilage. Both layers of foil must be brought together at the bottom of the tube and cemented to each other, so that the two layers practically form one sheet of foil. Unless this is done the glass will become electrified by friction, and the action of the magnets thus rendered uncertain. The tube is fastened in any suitable base, such as a block of wood, B. The magnets, SN and NS, are made by taking two short pieces of needles or steel wire of the same length and diameter, making their ends true, and then magnetizing them. They are then fastened in a piece of stiff paper, P, as shown, with their poles reversed, and should lie in the same vertical plane. Care and knowledge of the art of magnetizing are requisite in order that the combination, when suspended in the tube by the fibre F, shall *just* point north and south, and yet be caused to deviate from this line by bringing a piece of iron or steel not more than ½ of an inch long within about 6 inches of the tube. If the magnets should have the same strength, and have their magnetic axes in the same vertical plane—things which rarely occur in practice—the combination will point east and west, as happened with the first set made by the writer. When this occurs the strength of one of the magnets must be very slightly diminished, and the combination again tested while in the tube. The paper to which the magnets are attached must be thoroughly dried, and then varnished, before it is used, and the suspended device must be well balanced, and be as light as possible. A cork, C, closes the upper end of the tube, and has fastened to it a wire hook, H, to which the upper end of the silk fibre is secured.

Before using the detector, see that *all* articles containing iron or steel, such as knives, keys, and wearing apparel, are removed at least three feet away from where it is to be placed, and that they remain stationary. Place the detector on any steady support, with the openings in the foil (which should be as small as possible) and magnets in a north and south line. Then move the member supposed to contain the metal about the tube in different directions, without touching it, however, and if any iron or steel approaches within about six inches of the tube the needles will surely move, provided that the apparatus has been properly made and adjusted.

TELEPHONE SUBWAYS FOR JERSEY CITY.

THE NEW JERSEY STATE ELECTRICAL SUBWAY COMMISSION has adopted resolutions giving subway privileges to the New York and New Jersey Telephone Co., in Jersey City. The subway commissioners have directed that creosoted wood or other suitable material be used in the construction of the conduits. The conduits must be 18 inches under the surface of the street, not less than one foot outside of the curb line and the same not more than three feet in width and six in depth. All manholes must be kept below the surface of the street. The conduits must all be used for the operation of the police and fire lines unless they should obstruct the wires of the company used for its own business.

A CENSUS OF CARRIER PIGEONS.

THE French Minister of War has ordered a census to be taken of all the pigeons in France, that would be available for carrying dispatches in time of war. They are all to be numbered; those attached to the military establishments, those which belong to pigeon flying associations and clubs, those that are the property of the farmers and landowners. Thoughts of pie must be banished now that the pigeons are of national importance.

ELECTRIC RAILWAY DEPARTMENT.

IRISH'S CLOSED CONDUIT FOR ELECTRIC RAILWAYS.

BY

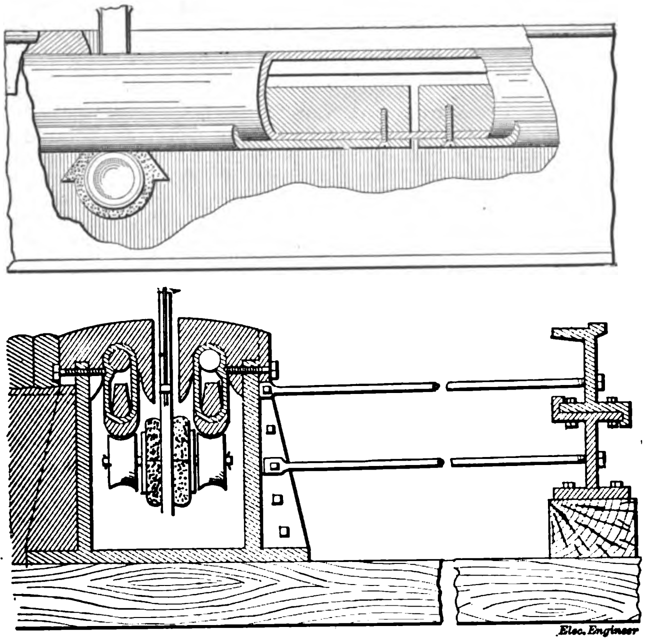
W. E. Irish

In this system, which is an improvement on the writer's previous work in this field, the conductor is completely enclosed and held rigidly in an insulating, elastic, water and dust-tight tube about one inch in diameter. The circuit is opened and closed by the pressure, or release from pressure of the trolley on the walls of the elastic tube. The trolley travels with an elastic pressure against a sectional rail composed of circuit-closing pieces secured to the outside of the flexible tube. These sectional rails are connected by means of screws through the walls of the elastic tube to similar sectional pieces within the tube, thereby forming pairs, each pair being insulated from the next by a space so that the rubber tubing intervening forms a flexible hinge between them and permits of their being independently raised in contact with the feed or trolley wire.

The interior contact pieces are normally separated by their weight and by the elasticity of the tube from the supply wire, until the arrival of the car, when the pressure of the trolley against the sectional rail, compresses the walls of the tube until the interior sections touch the supply wire, by which action the circuit is closed.

As the trolley advances, each sectional pair as passed, will spring away from the conductor. but not before other sectional pieces or pairs have been forced in contact so as to maintain the circuit closed ; there is, therefore, no sparking at the trolley.

The mechanical construction of the conduit is clearly illustrated in the cross-section, Fig. 1, which shows the conduit, trolley and sectional conductors with the circuit open and the trolley out of action. In Fig. 2 the wall of the conduit is broken away showing the trolley, elastic tube, and outer sectional conductor. The wall of the rubber tube is also broken away to show the conductor and interior sectional conductors, which are out of contact with the supply conductor.

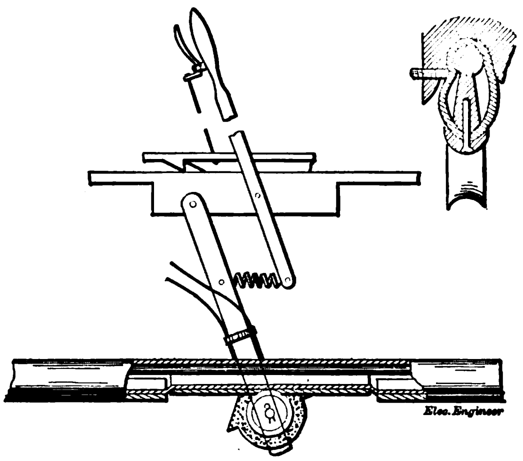


Figs. 1 & 2.—Irish's Closed Conduit for Electric Railways.

Fig. 3 shows a double trolley in action and pressing sectional pairs against the conductor.

Fig. 4 shows a cross section of the elastic tube, conductor, and sectional pair, in position when the circuit is closed.

From the engravings it will be understood that the supply conductor is rigidly fixed and located in the upper part of the elastic tube, while sectional conductors are located in the lower part where they are connected through the walls of the tube to exterior sectional conductors, of the same length, by screws. Normally the sectional conductors are not in contact with the main conductor but they touch when the trolley presses against them, because the tube is flexible. The conductors are retained in place by screws, which force rubber plugs against the flexible tube, and conductor, and clamp them in position against the wall of the recess, which is provided for the tube and conductor, in the cover of the conduit. The flexible tube is closed at intervals so that should it become injured and expose, at any point, the conductor, water or moisture could only enter the section injured.



Figs. 3 & 4.—Irish's Closed Conduit for Electric Railways.

The trolley is carried on a pivoted lever under the car, and is connected to the hand lever by a spring, which insures, when the trolley is active, a flexible pressure of the trolley against the sectional conductor. Thus, when the handle is operated and the trolley is moved along the conduit, it raises the sectional conductors until they come in contact with the main conductor, when the circuit will be established from the conductor to the trolley and thence to the motor and back by the second trolley; or, when only one trolley is used, by the conduit and rails. The trolley may be released, so as to open the circuit instantly, by pressing either by the foot, on the tread trip, or by the hand, on the hand trip.

With a good rubber tube the cost estimated will compare favorably with that of the trolley system.

This system possesses the advantages among many others of being absolutely free from danger to life or property, and of involving no loss of current by leakage.

The rubber tube, contained as it is in a damp dark chamber where it is not subject to extreme or sudden changes of temperature would last many years without the least deterioration.

The conduit measures about fifteen inches deep and seven inches across the exposed part of the cover. The conduit and the rails are adjustable one with the other by the ties, so that if by any chance the slot should get out of alignment, it can be easily and readily readjusted.

The conduit is cleaned, as found necessary, by trailing a scraper through it; the scraper as it collects the dirt, etc., dumps the same at the manholes, placed at frequent intervals, as it passes. From these the dirt can be removed as occasion requires.

ELECTRIC TRACTION BETWEEN MINNEAPOLIS AND ST. PAUL.

The success of the electric trolley road between St. Paul and Minneapolis, is so pronounced that the short line service over the steam railroad has been abandoned, only the regular through trains now taking such passengers as may wish to travel the 10 miles in that way at the higher rate of fare.

THE WYNNE SYSTEM OF ELECTRIC TRACTION.[1]

Our readers will remember an accont upon the Wynne tramway system, which we printed some time since.

The leading feature of this system is that only those sections actually covered by the moving car are connected with the buried conductor. The sections are 5 feet long, and five at least are always covered by the car; they are laid on asphalt concrete, and are run in with bitumen, which affords tolerable insulation between the sections and from the earth. These sections are charged in pairs as the car moves over them. Mr. Wynne has recently modified the details of his system, and by placing the contact boxes between two sections, he is able to reduce the number of magnetic switches while retaining the important principle that only those sections which are under the car and its platforms are charged. The contact boxes are placed at intervals of 10 feet, and their covers constructed on the diving-bell principle. The connections are easily accessible, and the contacts may be quickly replaced. A part of the line in Fig. 1 shows a contact box with portions of the crenellated rails.

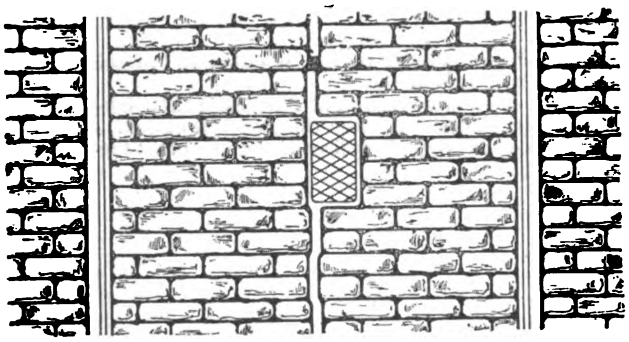


Fig. 1.—Part of Track Showing Tram Lines, Mid-Rail, and Contact Box.

In Fig. 2 two sections and a plan of the contact boxes are shown, together with a section of the mid-rail, showing the buried conductor. This conductor is led into the box and the two ends are brought up and sweated to a double shoe from which the current is tapped off. This shoe is a single casting, and consists of two ferrules united by a cross piece. The ends of the conductor sections are turned up and enter these ferrules, one of which is shown in the side elevation of the contact box. A pair of split contact springs are provided, and the shoe is connected to the lower one. Two tubular magnets A and B are mounted in the box, one vertically and the other horizontally to save space. Two insulated wires are connected to the upper contact spring. One goes to one magnet and thence to the cast iron case of the box, putting it in connection with one section of contact rail. The second wire goes to the other magnet, and thence runs alongside the main conductor for a short distance back along the line to the next section of the contact rail. A double armature, C C, carries a copper contact wedge, D, which is thrust between the contact springs when either or both of the magnets are excited.

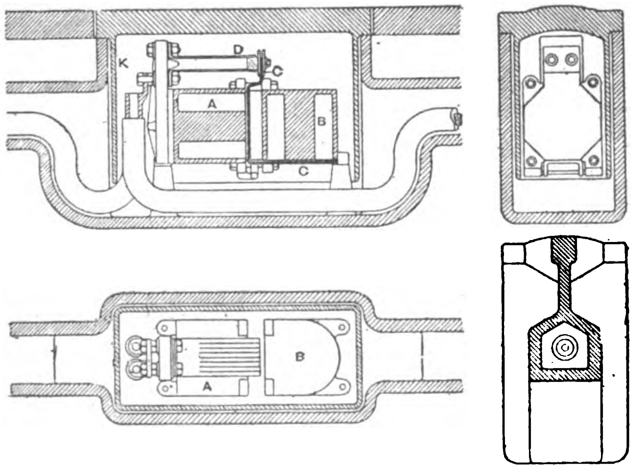


Fig. 2.—Details of Contact Box and Section of Mid-Rail.

A diagrammatic view of the system is given in Fig. 3, where seven sections or parts of sections of the mid-rail are shown, lettered A, B, C, etc. The sections A and B are not yet connected with the buried conductor; C and D are so connected, and E and F are just about to be cut out. When this is done the armatures fall back by gravity. The contact between the conductor and the section F is maintained by the magnet in series with section E. The current passes from the brushes through the motor, and thence by the wheels and rails to earth. In the event of the breaking of the circuit, the contacts in the boxes fall open. To enable connection to be re-made two or three secondary batteries are carried on the car, and being arranged with a small resistance of about ¼ ohm, as shown in Fig. 3, are kept always charged.

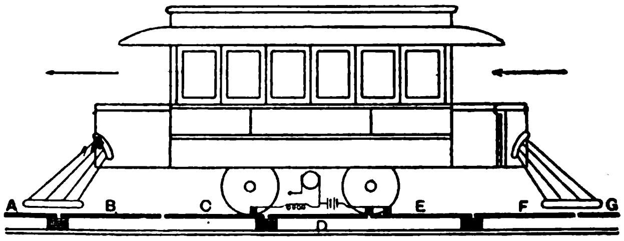


Fig. 3.—General Arrangement of Wynne System and Diagram of Connections.

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[1] London *Electrician*.

HOW SHALL ELECTRIC RAILWAYS BE TESTED?

BY

E. A. Porter.

I have read with interest the test of the Biddeford and Saco Railway Company's plant, but ask permission to make some remarks on the same.

The cost of coal per car mile may be a good standard for the comparison of the entire plants (station, cars, track and feeders) of different street railway companies, but it is of little value in the comparison of the efficiencies of power stations.

A far better standard for comparing the efficiencies of different power stations is the *number of pounds of coal per electrical horse power per hour* and the best standard for comparing the efficiencies of the engines, shafting, belting, and dynamos of different stations is the *nnmber of pounds of water per electrical horse power per hour.*

In the test of the Biddeford and Saco Railway Company's plant as given in your issue of Nov. 23, 1892, the mean electrical horse power is 50, the number of pounds of water evaporated is 45,300, making 906 pounds of water per electrical horse power per day. Assuming that the length of the run was 20 hours we have 45.3 pounds of water per electrical horse power per hour; a result below that obtained in Cleveland as given in The Electrical Engineer of March 9, and April 27, 1892.

AN EMERGENCY TELEPHONE FOR ELECTRIC RAILWAYS.

An ingenious method of preventing delays on electric railway lines by affording immediate communication with the central station in case of an accident on any part of the road, is in operation upon the Port Defiance, Tacoma & Edison Railway. Connecting wires from a telephone pole line, along the track, extend down the poles to within a convenient distance from the ground. Each car carries a telephone outfit which can thus be readily attached to the line at any point and the trouble at once be reported to headquarters. Orders can then be received for the operation of the cars on either side of the break.

THE DEADLY ASH CART.

The other night an intoxicated man tried to board a moving electric car down town and fell, and narrowly escaped being run over by an ash cart that was coming in the rear. The deadly trolley must go.—*Reading Telegram.*

Connecticut.—It is stated that there are now 41 electric railway franchises asked for to be brought before the Legislature. Many of these are competitive and some will not be granted, but the residue will create a brisk demand in Connecticut for electric railway material.

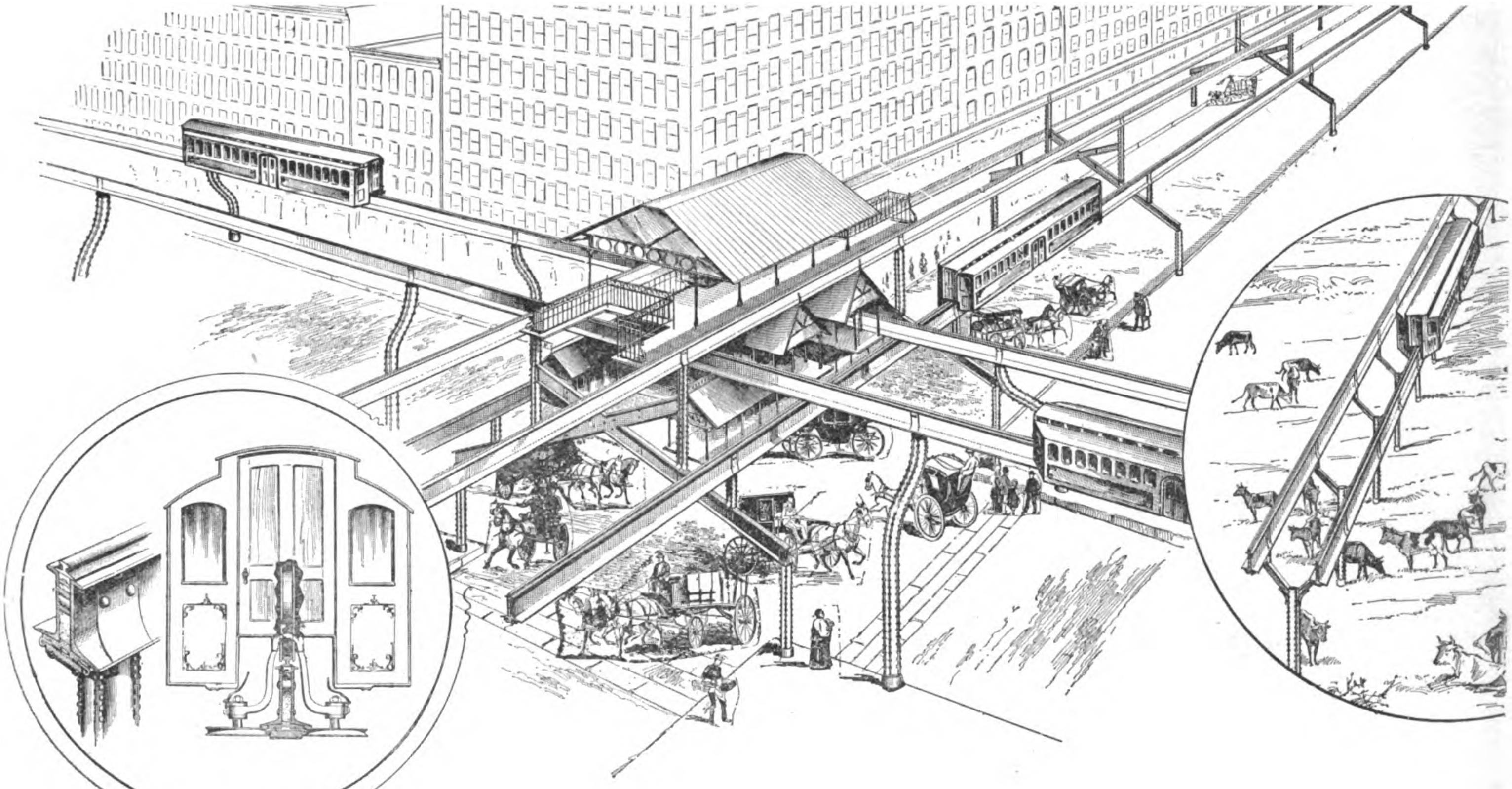
THE NEW "PRUYNWAY".

Rapid transit in cities has claimed the attention of engineers for many years, and judging from the present indications will continue to do so for a long time to come. With the electric motor available as a propelling agent the problem is vastly simplified and this fact has been taken advantage of by not a few engineers.

Among the recent attempts in this direction is that of Mr. Henry S. Pruyn, and our readers will be able to gain a good idea of his proposed method from the accompanying engravings.

The panel at the left gives a perspective view of the structure of the girder and of the rail which it carries on top of it and the two current-conductors carried under the lower flange, where they are not only insulated, but absolutely protected from damage by the weather or any other cause. Slightly below the level of these power current-conductors and between them and below the structure, is a space for telegraph, telephone, electric light and other electric lines which are also protected from interruption by snow, ice or other causes. As these conductors are firmly fastened and completely protected, there is no danger of short circuiting or leakage of the current.

In the Pruyn method of operating the electric power and current, the system does not depend upon the ordinary ground circuit. Instead of the return current being allowed to pass through the structure to the ground, it is passed from the generators stationed at suitable intervals along or under the railway line, out through the conductor at one side of the structure, and picked up and carried by a suitable truck-conductor to the car motor, and after having performed its work in driving the carrying-wheel which rests on the top of the main rail, passes down on the other side of the car, through a suitable conductor, into the opposite guide-wheel below, which delivers it to the current-conductor on that side and returns it to the original generating station where it again passes through the generating dynamo and out again to the line. The current makes a complete circuit. Thus, the electrical system is self-contained.



The New "Pruynway."

This arrangement not only results in economy of power, and prevents short circuits, but provides against induction from the heavy power-conductors used for propelling the cars, upon the telegraph and other conductors adjacent, as well as to all contiguous electrical lines whether included in the railway structure or not.

Again, atmospheric conditions have no effect on the electrical conductors contained in the Pruynway structure or supported by it, since the charge goes directly to ground through the structure.

The end elevation of one of the cars shows the car truck. At the top of the truck is seen one of the carrying wheels resting on the track rail, while at the bottom of the truck are seen the pair of guide wheels picking up the current from the conductor under one side of the structure while the other guide wheel returns it through the conductor on the other side, after having passed through the motor.

Each car is self-propelling and the cars may be run singly or in trains. The weight of the car and its load is carried low on either side of the track rail, and largely below it. The strengthening frame-work of the car is in the floor and a large proportion of weight in addition to this strengthening frame is in the low-hanging trucks of which there are two for each car. The carrying wheels bear the car by means of heavy pins with spring bearings on which the weight of the car rests. The carrying wheels run on and pass curves without the grinding action inseparable from the ordinary car truck which of necessity passes over a greater distance on curves with its outer wheels than with its inner wheels, compelling one or both wheels to have more or less sliding friction according to the abruptness of the curve.

Owing to the form of the railway and of its supporting the cars, the car floor is run about 10 feet lower or nearer the earth's surface than in ordinary elevated railways, while preserving an equal amount of clearance beneath the girder. This saves from 15 to 20 stairs in ascending to the stations.

The central view in the accompanying engraving shows the system as applied in cities, with a three-story station at the intersection of two streets, for the accommodation of passengers on either of the three lines of railway shown. Through express cars run on the two highest tracks of the main line; local accommodation cars run on the lowest pair of tracks nearly over the curbs on each side of the street. Cross-town cars run on the pair of tracks at a level half-way between the respective levels of the express tracks and the accommodation tracks running up and down town.

The view on the right hand will give an idea of the Pruyn method of construction for a cross-country, double-track road. A right of way, one rod wide, is sufficient for it. There are no grade crossings for wagon roads, foot-paths or railways, and thus no liability of damage to persons or property from passing trains, smoke, or accidental fires from locomotive sparks.

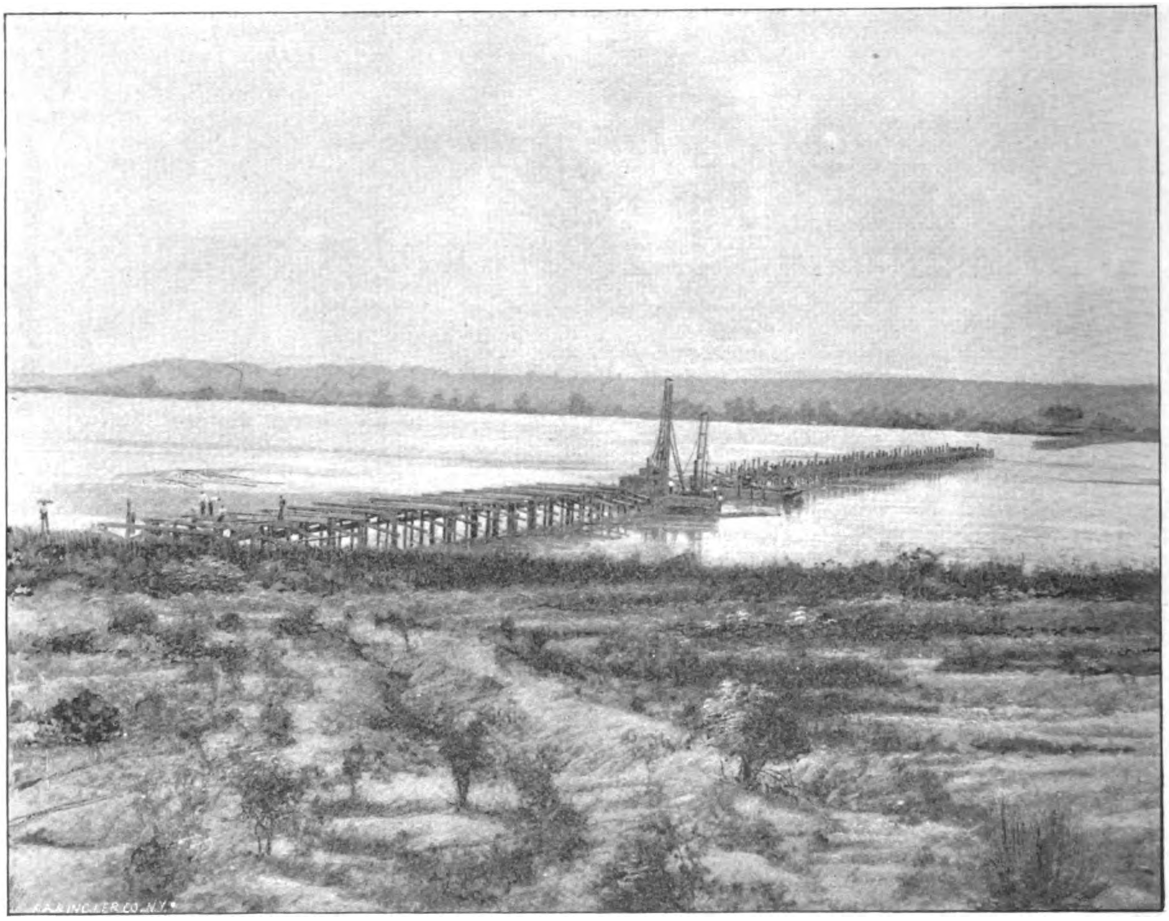
This system which is the invention of Mr. Henry S. Pruyn, 421 Rialto Building, Chicago, is now being exploited and Mr. Pruyn hopes to make a practical demonstration of its feasibility at an early day.

THE WASHINGTON, ALEXANDRIA AND MOUNT VERNON ELECTRIC RAILWAY.

THE operation of cars on a railway 10½ miles long, exactly two months after the contract was signed, which was accomplished by Mr. Charles H. Davis, C. E., of this city, as chief engineer of the Washington, Alexandria and Mount Vernon Electric Railway, is a feat almost, if not quite, unique, in the history of electric traction.

Ground was broken on June 18, the day on which the contract was made with the Mount Vernon Construction Company; steam was raised on September 15, and the road was opened three days later.

The accompanying illustration shows the trestle and draw bridge over Hunting Creek during process of construction. The trestle is 4,000 feet long and the draw has a span of 100 feet. The latter is built of plate girder and rests on a centre pier of iron and concrete. The rails are 50-pound T and 55-pound Wharton girder, and 900 28-foot poles with 10-inch butts and 7-inch tops support the trolley wires. Two 16-foot Brill cars, equipped with Thomson-Houston motors, are in use and make from 25 to 30 miles an hour.



CONSTRUCTING THE TRESTLE AND DRAW, W. A. & MT. V. ELECTRIC RAILWAY.

The power house is 92 feet long by 68 feet wide, and contains two Edison generators of 200 h. p. each, belted to two 200 h. p. Green engines, with 16 x 36 inch cylinders. The boilers are two in number, of 150 h. p. each, and were built by the Harrisburg Foundry and Machine Company.

Mr. Bertram P. Flint was the engineer in charge of the construction.

ELECTRIC RAILWAY ACCIDENTS—DECISION CONCERNING NEGLIGENCE OF PASSENGERS.

THE full bench of the Massachusetts Supreme Court, at Boston, on December 14, rendered a decision on a new point of law in the Albert E. Beal *versus* the Lowell and Dracut Street Railway Company. The plaintiff was riding on the front platform of an electric car, and was thrown to the ground in an accident caused by a defective switch. The court overrules the exceptions, and sustains the decision of the lower court which found the plaintiff guilty of negligence, because there attend the employment of electricity the same dangers that might attend the employment of steam; while it is not necessarily negligence for a passenger to ride on the front platform of a horse car while in motion.

UNDERGROUND ORDINANCE IN CLEVELAND.

THE underground ordinance has once more risen to the surface, and from present indications it is soon to be enforced. The city electrician, Mr. Geo. Hoag, has ordered the removal of the network of wires, which at present adorn the City Hall and these will be placed temporarily upon poles. There is a strong appeal from the Board of Trade, the Board of Underwriters and the Fire Department, for the removal of all overhead wires and the scheme at present is for the city to build and own the conduits and fix the rental at a price simply necessary to maintain the system. The local telephone company has opened war against the electric roads in their use of a ground return, advocating in its place a double trolley system. It instances the evil electrolytic effect upon the gas and water mains, as given in the report of Mr. Morse, Supt. of Telegraph, of Cambridge, Mass., and also cites the experience of the West End road in Boston.

CLEVELAND NOTES.

NEW ELECTRIC ROAD.—The City Council of Cleveland, at its last meeting, gave an unconditional franchise to the Cleveland City Cable Railway Co., permitting them to equip their St. Clair road, the last of the horse lines in Cleveland, with electricity. The franchise was so worded that the Company also have the privilege to change their cable road over to the trolley system, of which privilege they are sure to avail themselves at the earliest possible opportunity. At the same meeting, the council received from two local societies, both being strong advocates of municipal ownership of the telegraph, telephone, etc., resolutions to the effect that the city build and operate a belt line around the city, connecting Wade and Gordon Parks.

The council nodded its approval by passing a similar resolution and referring it to the Director of Law, to see if there were any legal obstacle in the way.

LEGAL NOTES.

THE EDISON-SAWYER-MAN LAMP CASE—II.

EDISON ELECTRIC LIGHT COMPANY AND EDISON GENERAL ELECTRIC COMPANY *vs.* SAWYER-MAN ELECTRIC COMPANY. FINAL HEARING BEFORE THE UNITED STATES CIRCUIT COURT OF APPEALS.

MR. ROOT, continuing for the defendant (appellant), said that combinations like the General Electric Company had been repeatedly denounced by the courts, both state and federal, as being in contravention of common law and contrary to public policy. He then cited a list of cases sustaining his view. The form or method adopted to effect the combination was of no consequence. No form leaving the parties combining still in existence and owning their own property had ever escaped the condemnation of the court when such combination was to secure a monopoly and in restriction of competition. He cited the cases of the Sugar Trust (54 Hun. 354): the State of Ohio *vs.* The Standard Oil Company (30 N. E. Rep. 279), and American Biscuit Company *vs.* Klotz, in the Circuit Court of the United States for the eastern district of Louisiana (44 Fed. Rep. 721). In the latter case the court had gone so far as to hold that where a corporation had been organized for the purpose of combining a large number of bakeries, and had actually purchased their property, that arrangement, because of its effect at large, was such as to justify the court in refusing to grant a receiver *pendente lite* upon the ground that the purpose of the complainant was such that a court of equity ought not to give it any assistance. After further citation of cases, and further argument upon this aspect of the case, Mr. Root dwelt upon the inter-relations of the Edison Company, the Thomson-Houston Company and the Westinghouse Company, claiming that an injunction would assist the General Company to substitute Thomson-Houston alternating apparatus for Westinghouse apparatus in many plants throughout the country, and that, as the Westinghouse Company was under contract not to sell any incandescent lamps to users of the Thomson-Houston apparatus, the early expiration of the Edison patent would leave the Westinghouse Company under the disadvantage of inability to supply lamps to plants originally equipped with their own apparatus, so long as their contract with the Thomson-Houston Company remained in force.

Mr. Lowrey, for the complainants (appellees) followed Mr. Root and devoted his argument mainly to the consideration of the equities and inequities alleged on either side. He pointed out that the combination, so eloquently complained of by Mr. Root, had been made after Judge Wallace told the world that they must not make Mr. Edison's lamps, that it was unlawful to do so. At the time of Judge Wallace's decision the complainants had been seeking an injunction to stop the Thomson-Houston Company from manufacturing those lamps. Were they forbidden to settle out of court with a party willing to be settled with? The combination had simply brought in a recalcitrant and rebelling party. Counsel on the other side might ask what was to be the policy of the General Company, and what it would do in respect to selling lamps to persons holding Westinghouse apparatus. Mr. Lowrey would repeat, in substance, what was answered in their brief on that point, namely, that he did not suppose any man living could answer that question. It was quite improbable that any policy could be resolved upon which would take into consideration so large and so complicated a mass of business, in which, in this city, there was an Edison licensee claiming a right against a licensee of the Thomson-Houston Company and against a licensee of the Westinghouse Company, all three of whom the General Company desired to make its friends, to secure their business, to establish relations which would enable them to go on harmoniously, and to reduce the injury to any one of them to a minimum. To accomplish this was a work almost of statesmanship; no Board of Directors, much less any drummer out West, could undertake to say what would be or what ought to be the policy of the General Company. If their Honors were wiser than all the Judges who have ever sat and if they possessed all the practical acumen which business men own, they could not announce at this time about this business any safe, judicious, and fair rule than that the whole matter will have to be dealt with fairly and upon business principles, giving to each case its proper consideration as it arises.

In respect to the affidavits charging the complainants with an intention to make an oppressive use of the injunction—that is to say, refuse to sell to somebody—Mr. Lowrey was authorized to say that it was not the intention of the General Company, or of the complainants, to refuse to sell lamps for use on Westinghouse machines. They desired to sell their lamps everywhere, had put them in the hands of supply dealers for sale and did not intend to take them out of the supply dealers' hands; anybody who wanted to buy them would continue to find them there, and there was not a thing in this case indicating the contrary.

In respect to the right of complainants to the injunction, counsel maintained that since Congress passed the first patent law an injunction had never been refused a patentee whose rights had been juducially settled out and out; the cases, he believed, sustained this proposition absolutely. This court was now asked to take a new step, and for the first time to restrain a manufacturer, whose right was clear, at the suit of a manufacturer whose infringement had been proven.

In respect to the argument of the other side upon "public convenience", Mr. Lowrey claimed that the people who would be inconvenienced were in no proper sense "the public"—not the "public public"—it was a "private public"—it was a public engaged in the business of using lamps for their own convenience, in factories and elsewhere—quite different from that public whose rights were common and indistinguishable in the streets and such places. It was nothing but a very extended and enlarged number of minor and subordinate infringers.

THE COURT (Judge Wallace)—Does it make any difference whether the lamps are located in the streets or inside of houses or factories?

MR. LOWREY—I do not think so; but I am trying to deal with my friend's effort to raise up a phantom public.

THE COURT (Judge Wallace)—It is just as much a public use if these lamps are used in factories or in private dwellings as if they were used on the streets. They are used in the same places that water and gas are used in.

Continuing his address, and passing in review further points relating to public convenience and to the alleged intention to withhold the sale of lamps to Westinghouse users, Mr. Lowrey made an appeal in behalf of the Edison licensees, who had been waiting many years for rights hitherto denied them. When they heard the recent judgment of this Court they thought the time had come at last when they should receive that for which they had bargained and paid. He would ask the Court in looking at users, to think of those users who had obeyed the law, who had paid great sums, and who were now waiting to see whether there was anything in it when a man wins a big patent case.

Mr. Seward followed Mr. Lowrey, closing the argument for the complainants. Touching somewhat on points gone over by Mr. Lowrey, and in the United States Company case, he gave attention chiefly to that part of the defence based upon state and federal legislation against monopolies and restraint of trade and upon common law doctrine in these regards. After contending that the combination—the General Electric Company—was entirely a legal one, he claimed that even if it were illegal, the present case would be within the familiar principle of law, referred to by Mr. Lowrey, that the test of whether the illegality prevented recovery was whether the plaintiff must trace title through the illegality in order to reach the parties. The complainants were not the General Electric Company, nor did they trace title to the patent through that company.

Referring to the anti-monopoly and anti-trust aspect of the case, Mr. Seward said that the Court had nothing before it to show that the General Electric Company, if it were the plaintiff upon the record, was doing anything forbidden by law. No evidence was given of any contract, or of any act, tending to show that complainants or the General Company were striving to effect an illegal restraint of trade or to create an illegal monopoly. It appeared from the papers in the case that every company controlled by the General Company had been formed for the production of patented articles; some to make lamps, others to make dynamos, etc. The monopoly would therefore be wholly based upon patents—a legal and recognized monopoly.

MR. WETMORE closed the case for the defendant (appellants). He began by asking what would be the irreparable injury if the preliminary injunction were vacated during the pending of the suit and the defendant were permitted to supply lamps to Westinghouse users meantime. Was the preliminary measure which might be recovered for the infringement during the pending of the suit made inadequate or insufficient?

After argument on the point of estoppel on account of the well-known relations of the Thomson-Houston, Sawyer-Man, Consolidated and Westinghouse Companies, Mr. Wetmore proceeded to urge that under no circumstances were the complainants entitled to an injunction which would be free from the condition that they supply the users of Westinghouse apparatus to meet the orders of defendant upon reasonable terms. Counsel on the other side urged that the complainants did not intend to refuse to sell the defendant lamps.

THE COURT (Judge Lacombe)—They do not exactly say that. I do not understand that they dispute the fact that they do not intend to sell lamps to the defendant, the Sawyer-Man Co.. What they say is they do not intend to refuse to sell lamps to the users of the plants that are established. I do not understand that there is any statement on their part that they expect to sell lamps to the Sawyer-Man Company.

Mr. Wetmore continued arguing in favor of a restriction or modification of the injunction which would compel the complainants to sell lamps to Westinghouse users upon reasonable terms. That was the condition which he thought should be put into any injunction that should be granted. There was no difficulty about that. Every man knew whether terms were reasonable or unreasonable. In case of controversy they could go to the court and determine whether or not there was a breach of that condition.

But, to make a distinction now and say that they could fill orders directly to customers, but that the Westinghouse Company could not give an order, was just the thing that would cripple the Westinghouse Company and prevent its continuance in business. That company was obliged, in carrying on its business, to furnish central stations with apparatus. Perhaps the meaning of the complainants was that the Westinghouse Company must not build any more plants, that they must suffer for the plants already built, and that they must go out of the business in the future.

THE COURT (Judge Lacombe)—I understand that to be the claim.

Mr. Wetmore said that it would then, of course, be idle to talk about the past if they could impose upon the defendant a condition which would drive the Westinghouse Company out of business, by laying their hands upon one single branch of it. Was that equity? Was that necessary?

Judge Wallace asked Mr. Wetmore: "What right have you to complain of that? You entered upon this enterprise with a knowledge of this patent; as business men you took the chances." Mr. Wetmore in reply assented saying: "But what chances did we take? We did not take such chances as this into consideration. We did not suppose under any circumstances, if the patent were finally sustained, that we could not buy lamps as well as anybody else; nor was any such policy suggested." Judge Lacombe here asked if it was a matter wholly unheard of in industrial history that the owners of patents had over and over again kept them entirely to themselves and been themselves the sole manufacturers.

Undoubtedly not, said Mr. Wetmore, but he was not aware that when a business, commenced as this had been, had grown up and been carried on as this had been, the owner of a patent after furnishing the public generally, for the public convenience, and all classes of the public his invention, could refuse to furnish the one excepted class.

At the close of the argument, Thursday afternoon, Dec. 8, Mr. Chaplin handed to the court the brief which he had been permitted to offer in behalf of the Mather Electric Company and of the United States Attorney for the District of Massachusetts.

THE EDISON LAMP DECISION SUSTAINED AND THE SAWYER-MAN CO. ENJOINED.

A DECISION was handed down on Dec. 15, by the United States Circuit Court of Appeals for this circuit, Judges Wallace, Lacombe, and Shipman sitting in the case of the Edison Electric Light Company against the Sawyer-Man Electric Company sustaining the decision of the Circuit Court granting a preliminary injunction against the Sawyer-Man people, restraining them from making any incandescent lamps in accordance with Edison's lamp patent No. 223,898.

Dyer & Seely Co. were the attorneys for the Edison Co., and Kerr & Curtis, for the Sawyer-Man Co.

The decision runs as follows:

UNITED STATES CIRCUIT COURT OF APPEALS.

For the Second Circuit.

EDISON ELECTRIC LIGHT COMPANY, AND EDISON GENERAL ELECTRIC COMPANY, Appellees, *vs.* SAWYER-MAN ELECTRIC COMPANY, Appellants.

Per Curiam.

This is an appeal from an order of the Circuit Court, granting an injunction *pendente lite* restraining the defendant from making, using, or vending the incandescent electric lamps of the patent granted to Thomas A. Edison, January 27, 1880, No. 223,898, of which the complainants are the owners. The order was granted *pro forma*, in the view that a final disposition of the questions involved might be promptly made by the decision of this Court.

The validity of the patent, and the infringement of its second claim by such lamps as the defendant makes, were adjudged by the Circuit Court for the Southern District of New York, July 14, 1891, in a decree at final hearing. That suit was brought against the United States Electric Lighting Company, and was defended by the Westinghouse Electric Company, a corporation which since October 10, 1888, has been the owner of the business carried on in the name of the present defendant. The business of the defendant consists exclusively in the manufacture of the infringing lamps. The decree of the Circuit Court adjudging the validity of the second claim of the patent, and its infringement by lamps such as are made by the defendant, was upon an appeal affirmed by this Court, October 4, 1892. That decree among other things awarded the complainants a perpetual injunction. The present suit was brought subsequently to that affirmance.

It is apparent that the order for the present injunction is in effect one to extend the terms of an injunction already granted in a suit determined by the Court of last resort between the same parties, or their privies, so as to include a new infringement. For an understanding of the grounds upon which the defendant contends the injunction ought not to have been granted, the following narrative is necessary:

For several years subsequent to 1880, the Edison Company and the United States Electric Lighting Company were the only manufacturers of incandescent lighting apparatus in this country doing any considerable business. The United States Electric Lighting Company began manufacturing incandescent lighting apparatus, including the lamps which have been held to be an infringement of the Edison patent, in the summer of 1880, and continued in such business until a recent period. In May, 1885, a suit was brought against it upon the present patent. Another corporation, the Consolidated Electric Lighting Company, was organized in September, 1882, and began the manufacture of incandescent lighting apparatus. This company was the owner of and operated under what are known as the Sawyer-Man patents for electric lighting apparatus; and under these patents it assumed that it had the exclusive right to make and sell the lamp claimed in the patent in suit. In May, 1885, suit was brought against it by the Edison Electric Light Company upon the patent in suit, and about the same time it brought suit against the Edison Company for infringement of its own patent. In 1883 a corporation known as the Thomson-Houston Company began the manufacture and sale of electric apparatus for lighting and power. As the result of negotiations between the Consolidated Electric Lighting Company and the Thomson-Houston Company, the Sawyer-Man Company, the present defendant, was organized in September, 1886. Nine-tenths of its stock was owned by the Thomson-Houston Company. It received from the Consolidated Company a license to manufacture lamps under the Sawyer-Man patents, and thereupon began the business of manufacturing the infringing lamp, and has continued in this business to the present time. In August, 1887, all the stock of the defendant, including that owned by the Thomson-Houston Company, was sold to the Consolidated Company for $120,000 in bonds, and the same amount at par of its stock. In December, 1888, the Thomson-Houston Company sold its stock in the Consolidated Company to the Westinghouse Electric Company. At the same time, by an agreement between the Consolidated Company and the Westinghouse Company, the fulfillment of which on the part of the Consolidated Company was guaranteed by the Westinghouse Company, the Thomson-Houston Company was licensed under the patents of the Consolidated Company to make incandescent lamps for export and use with generating apparatus of its own manufacture in this country; and the Westinghouse Company was prohibited from selling incandescent lamps for use with the Thomson-Houston generating apparatus for a period which might, at the option of the Thomson-Houston Company, extend to 1902. This agreement recognized the fact that the Thomson-Houston Company could during the continuance of the agreement make and sell lamps not covered by the Consolidated Company's patent; and in the event of such manufacture and sale, the latter company was released from its obligation not to sell lamps for use in connection with the Thomson-Houston generating apparatus. Pending the suit against the United States Electric Lighting Company, the Westinghouse Company succeeded to the business of the United States Company, the Consolidated Company, and the defendant; and since September, 1888, the defendant has been the manufacturer of lamps for the Westinghouse system. Each of the various companies engaged in the manufacture and sale of electric lighting apparatus has, as a rule, manufactured all the different pieces of apparatus which are necessary for making up a complete "plant," the different parts being constructed with reference to use with each other, and not so as to be adapted for use in the systems of apparatus made by other manufacturers. For the purpose of public lighting from central stations, local companies, known as illuminating companies, have been organized in various cities and towns, which have purchased plants from one or the other of the manufacturing companies, and the central stations of such illuminating companies have, as a rule, been equipped wholly with the electrical apparatus made by some one manufacturing company. In many cities and towns there are competing illuminating companies using the system of different manufacturers, some being equipped with the Edison system, some with the Westinghouse system, and some with the Thomson-Houston system.

The United States Company has installed about 1,050 plants, with a lamp capacity of about 350,000 lamps. About 300 of these plants were installed before the suit upon the patent, was brought against it. The Consolidated Company also installed a large number of plants. After the Westinghouse Company succeeded to the business of the United States Company and the Consolidated Company, it also installed a large number of plants.

It is said that the aggregate lamp capacity of the incandescent lighting plants installed with generating apparatus supplied by the Westinghouse Company at the present time represents a capital of about $25,000,000, and a lamp capacity of over 1,300,000 lamps. The lamps themselves represent but a small part of the cost of the plants, the greater part being represented by the electric apparatus supplied by the Westinghouse Company and its predecessors; but the lamps are essential for the continued operation of the plants. Unless the lamps can be replaced as they are worn out, and can be procured when needed, these plants will be crippled and the greater part of the investment in them will be lost. The central station plants supply lights to consumers as gas companies supply gas; and if their operation should be stopped great inconvenience to the public would ensue. The various companies give employment to a large number of men who might be thrown out of employment if the lamps could not be obtained.

In 1889 the Edison General Electric Company was organized for the purpose of combining the Edison Electric Light Company with various other corporations engaged in the manufacture and sale of electric apparatus, the organization of the subordinate corporations being retained. Prior to April, 1892, the Thomson-Houston Company had acquired the stocks of various other companies engaged in the business of manufacturing and selling electrical apparatus, and these companies were carrying on the business in combination with the Thomson-Houston Company and under its control. In April, 1892, these two combinations, the Edison General Electric Company, and the Thomson-Houston Electric Company, included substantially all the companies which had theretofore been competing in this kind of business, excepting the Westinghouse Company; and in that month the General Electric Company was organized for the purpose of combining these two combinations in one which should include all the concerns in this country, except the Westinghouse Company, which formerly were competing in the business of making and selling electric light and power apparatus; but the separate organization of the constituent companies was still retained.

The defendant insists that the preliminary injunction should not have been granted because: (1) Owing to the laches of the owners of the patent in asserting their claims and enforcing them, a large capital has been invested in the manufacture and sale, not only of the lamps, but also in electric lighting apparatus, which will be greatly depreciated in value unless the lamps can be used with it, and that an injunction will cripple and perhaps ruin the local illuminating companies who have invested in the plants of the Westinghouse Companies if they are prevented from using the lamp of the patent, and thereby subject to great inconvenience those whom these plants furnish with light, and displace a large number of persons who are employed in operating the plants; (2) Because the complainants and the other corporations with whom the complainants are associated, the competitors of the Westinghouse Company in business of making and supplying electric power and lighting, have entered into an unlawful combination to stifle competition in that business, and an injunction will be used unconscionably to further the objects of the combination; and (3) Because by reason of the affiliation of the Thomson-Houston Company with that combination and the prior dealings of that company with the defendant, the Consolidated Company, and the Westinghouse Company, an equitable estoppel has arisen by force of which the complainants, as parties to the combination, ought not to be permitted to have an injunction. The question whether there has been any laches in asserting the patent was considered by the Circuit Court of Appeals upon the appeal from the decree of the Circuit Court, and that court declared that no case was shown to authorize the refusal of an injunction on any theory of laches or equitable estoppel by reason of undue delay in bringing suit, or acquiescence in known infringement. If the owners of the patent proceeded with due diligence as respects the United States Lighting Company, no other infringers of the patent can be heard to complain with reason that suit was not brought against them upon the patent previous to the adjudication of its validity in the Circuit Court. It is a matter of notoriety that the litigation was a very expensive and arduous one; and its progress must have been familiar to all those who were extensively interested in having the patent defeated. As regards the present defendant, there are no new facts of importance bearing upon the question of laches to distinguish the case from that shown in the former suit. We see no reason for changing the opinion expressed by this court in the former case, and do not deem it necessary, because the same defence has again been urged upon substantially the same state of facts, to add anything to that opinion.

Every one of the manufacturing corporations, the competitors of the Edison Companies, commenced their operations with a knowledge of the existence of the patent in suit. They were controlled by business men of intelligence and experience. Their promoters and managers may have believed, and probably did, that the patent could not be successfully maintained. But they entered upon the business with an understanding of its risks, and of the consequences which would befall them as infringers, if the patent should be sustained. None of them can now be justly heard to say that an injunction which is essential, if not indispensable, to the protection of the owners of the patent and their licensees, ought not to be granted because of the great pecuniary loss which may result. If in consequence of being deprived of the use of the lamps, their investments in other electric apparatus will be greatly depreciated, they must take the consequences.

The users who have supplied themselves with electric lighting plants from the infringers, which required for their operation lamps of the patent, are of course infringers. But those who did so before the decision of the Circuit Court sustaining the patent and at a time when judicial decisions in foreign countries interpreting the patent were in conflict, and who are now willing to accept their lamps from the complainants upon reasonable terms, have much stronger equities than the manufacturing infringers. These equities the court will not disregard; but what would be reasonable terms, if an application were made to the court on behalf of these users, is a question which can only be determined in each case upon its particular circumstances.

As to those users, however, who have acquired these plants subsequent to the decision of the Circuit Court, if they are deprived of the use of the lamps, and as a consequence the value of their plants may be greatly impaired, they must accept the result as a consequence of their own imprudence.

We are not disposed to investigate upon the present case the character of the combination which has been formed under the name of the General Electric Company. Whether that combination is intended to fetter competition, and is illegal as one in restraint of trade, is a question which we should not undertake to decide upon the evidence before us and in a suit to which it is not a party. The present complainants are entitled by the patent laws to a monopoly for the term of the patent, of the manufacture and sale of the lamps made under it; the right to this monopoly is the very foundation of the patent system. They do not lose that right merely because they may have joined in a combination with others, holding other patents securing similar monopolies, which combination may, when judicially examined in a proper forum, be held to be unlawful. We do not feel justified in assuming upon the facts before us in the present suit that the use which the complainants propose to make of the injunction, an injunction which seems necessary to secure their monopoly and make their patent fruitful, will be such as to promote any other monopoly. When it shall be made to appear that some one, to whom in fairness and good conscience these complainants should sell their lamps, has been arbitrarily refused them, save upon oppressive and unreasonable terms, it will be time to consider whether the complainants should be allowed to continue in possession of the injunction.

The alleged estoppel seems to be far-fetched and shadowy. The history which has been given shows that before the Sawyer-Man Company was organized litigation upon the patent in suit and upon the Sawyer-Man patents had commenced; that in 1887, the stock in the Sawyer-Man Company owned by the Thomson-Houston Company was sold to the Consolidated Company, a party to the suits; and that subsequently, in 1888, the Westinghouse Company, an actual party to the litigation, bought that portion of the stock from the Consolidated Company which had been owned by the Thomson-Houston Company. The estoppel lacks the elements which ordinarily create an estoppel in pais, namely, an injury or a harm to one person resulting from a reliance upon the acts, conduct or declaration of another, in which there was an element of bad faith or wilful neglect of duty. The history of the connection of the Thomson-Houston Company from 1886 to 1888 with the Consolidated Company, and with the Sawyer-Man Company, the defendant, shows that all those companies knew of the existence of the litigations in which the life of the present patent, and of the Sawyer-Man patent was at stake. There can be no charge of concealment or constructive fraud. When the sale and the agreement of 1888 were made there was no implied obligation upon the Thomson-Houston Company to remain in alliance with the Westinghouse system. The contingency that it might enter upon the manufacture of competing lamps was contemplated. Its union with the Edison interests has neither hastened nor facilitated the application for the present injunction. We perceive no adequate reason from the facts why the complainants should not obtain the ordinary results which attend a complainant's success in a suit in equity for the infringement of a patent.

The injunction order appealed from should be modified so as to cover only lamps made in infringement of the second claim of the patent, the other claims not having been infringed according to the adjudication of the Circuit Court or of this Court. It should also contain a provision reserving the right to the defendant to move hereafter for the vacation, suspension or modification of the injunction upon proof of specific instances of refusal on the part of the complainants or either of them, to supply the lamps of the patent upon terms reasonable under the circumstances of the particular case, to the owners of electric lighting plants which were installed before the rendition of the interlocutory decree of the Circuit Court sustaining the validity of the patent.

HUNT vs. JOHNSTON—DECISION ON APPEAL IN FAVOR OF HUNT

THE Supreme Court, general term, has affirmed the judgment, with costs, in the case of the W. J. Johnston Company against Walter T. Hunt and the Electrical Age Publishing Company. The plaintiff sought to restrain Mr. Hunt from working for the Electrical Age Publishing Company, but Judge Truax at the Special Term, on the 12th of May last, dismissed the action in favor of the defendants. This judgment was appealed from with the result above stated.

LETTERS TO THE EDITOR.

ANTEDILUVIAN TELEPHONE TRANSMITTERS.

I SUPPOSE that the impending expiration of Bell's multiple telegraph (several opinionated old gentlemen to the contrary notwithstanding) patent next March, is beginning to exert a fructifying effect on the inventive genius of the country, and that the evidences thereof will increase and multiply from this time on. I would suggest, however, to inventors of entirely new forms of telephones that when they test the novelty of their productions by the prior state of the art, it might be advantageous to continue their researches through the records of some of the old litigations. An example of the utility of this course appears on comparing "the solid back, long-distance telephone transmitter" illustrated in your issue of November 16, 1892, with Daniel Drawbaugh's ancient "tumbler" or "teacup" instrument, and observing the interesting similarities which exist. While it is quite true that the usual method of calling abusive names is an excellent answer to any allegations of priority affecting any instrument in which the powers that be are, or are likely to become, interested, it may be pointed out that the evidence of the existence of the said tumbler or teacup instrument a dozen years ago will be found in the records of the complainants in these old cases; and the fact that such instruments were used, not merely in a horizontal, but also in a vertical, position, was made the subject of specially virtuous indignation on the part of the Bell counsel in their comments on certain of the Drawbaugh tests. Meanwhile, I should imagine that the promoters of this last form of telephone would derive much pleasure from reading all the reasons which were adduced on the part of the Bell interest to prove that such an instrument, even if it existed at the still earlier date then in controversy, could never have worked satisfactorily.

But even this, like all pleasure, is merely relative. For do we not know, that nothing which can possibly happen during the next eighteen months will rival as a source of abstract joy and intellectual delight, the gyrations which a refurbished Bell Telephone Literary Bureau is going to make in order to reconcile anybody and everything in the interests of truth, justice and the Bell stockholders.

PARK BENJAMIN.

NEW YORK.

COMPOUND WOUND MACHINES.

APROPOS of Mr. Willis' recent paper before the Chicago Electric Club on "Compound Wound Generators," let us have a little light on the subject of the "variable shunt" on the series field.

The Thomson-Houston machine has a German silver fluted strip very familiar to most of us. In years past in many instances to the writer's knowledge, these shunts were removed from incandescent machines without any appreciable bad result. Quite recently two 100 K. W. Edison railway generators were carefully tested for effect of varying this shunt to the series coil. No change of voltage could be discerned with or without load, and with the machines both hot and cold. Engineers of experience who have been questioned report similar results of non effect of variation.

J. STANFORD BROWN.

THE SAFETY OF ELECTRIC ELEVATORS.

REFERRING to the comments by Mr. Rosenbaum in your issue of December 14, I have no doubt that my knowledge of the action and use of motors on elevator, as well as on other service, is limited, and I confess I am rather glad of it, for it leaves me the hope of learning something more; but I must be pardoned if I express myself as reasonably content with the limitations, such as they are, and decline to unnecessarily discuss the utility of the commonest and most easily handled electrical devices for protection of machines and circuits which may be called into play when the safety factor of the hoisting ropes is wilfully exceeded.

NEW YORK, December 16, 1892.

FRANK J. SPRAGUE.

THE DRIFTLESS BALLISTIC GALVANOMETER.

IN an interesting article in your valuable journal of Nov. 16, Mr. Elmer G. Willyoung gives an account of a ballistic galvanometer used by Messrs. Queen & Company. As a scientific man should do, Mr. Willyoung gives due credit to Mr. Northrup for an improvement in the needle for more easily adjusting the degree of astaticism. Though in this case he gives due credit for design, we fail to see why he omits to mention that the whole general plan is a barefaced copy of our ballistic galvanometer described in THE ELECTRICAL ENGINEER of April 15, 1891, and fully illustrated. All the confirmation required of this statement would be to print the two engravings side by side.

We should not have expected such treatment at Mr. Willyoung's hands, though we presumed the conscience of Messrs. Queen & Company, as traders, would be of a different order.

NALDER BROS. & CO.

LONDON, Dec. 1892.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE 72d meeting will be held at the Headquarters of the Institute, 12 West Thirty-first street, Wednesday, December 21, at 8 p. m. The change from the usual meeting night of Tuesday has been made in order to permit suitable preparations. The paper for the meeting is entitled: "Seven Years' Experience in Armature Insulation," by Mr. E. P. Thompson, member, for Messrs. C. W. Jefferson aud A. H. S. Dyer. Advance copies of the paper will be sent on application, and will be distributed at the meeting. There will be exhibits illustrating the steps in the manufacture of armatures and the results obtained. The author suggests the following topics for discussion in connection with the paper:

SUGGESTIVE TOPICS.

Armature.—Rigidity and its dependence upon insulating material employed. What has been learned by observation and special tests?

Preservation of Insulation.—Is it better to try to remove the cause of heating, or to neutralize the heat?

Burning Out Armatures.—What does insulation have to do with it, and what are the remedies? Also, what are the causes?

Durability of Insulation.—Differences in connection with armatures for inside use, such as installations and outside, *i. e.*, railway, mining and elevator use. Effects of atmosphere, motion and rough treatment.

Financial.—Does the expense of insulation, if the best, have an appreciable effect upon the cost of construction, and, on the other hand, will it pay in the end to put in a cheaper material?

Comparative Merits of Insulating Materials for Different Conditions.—Effects of high potential. Power to resist spark-puncturing. What have tests shown as to properties of materials to withstand "breakdowns," independently of high ohmic resistance?

The discussion will be opened by Messrs. W. J. Hammer, Chas. Steinmetz and Harold Binney. Dr. J. B. Williams will also make comparative tests of different samples of insulating material considered suitable for this class of work, and manufacturers and dealers are invited to send specimens to the secretary, which should be about two inches square and $\frac{1}{16}$ inch thick or less. Gentlemen who are not identified with the Institute, are cordially invited to attend.

BUFFALO ELECTRICAL SOCIETY.

AT a meeting of the Buffalo Electrical Society held December 5th, Mr. P. K. Stern read an interesting paper on Electric Heaters. The attendance at this meeting shows that the Society has opened the season with its old time enthusiasm. At the next meeting Mr. Frank Kitton will deliver a lecture on Magnetism, and at a subsequent meeting, Mr. A. C. Terry will lecture on the subject of Electric Motors, treating it in a popular and elementary way. The Society is considering the project of a series of lectures on Electrical Engineering known as the University Extension Course. The members of the Buffalo Society of Natural Sciences are very much interested in this course of lectures and the prospects are that the plan will be eminently successful. The lectures will be delivered by one of the best electrical engineers in the State.

The following officers have been elected for the years 1892–1893: President, Frank Kitton; vice-president, P. K. Stern; secretary, Astley C. Terry; treasurer, Samuel Stewart; librarian, John G. McNerney; executive committee, Frank Kitton, A. C. Terry, F. P. Jones, John P. Chapin, P. K. Stern, Samuel Stewart, F. A. Hallock, Geo. A. Burnett.

THE MANCHESTER, N. H., ELECTRIC CLUB.

THE Manchester Electric Club is meeting with astonishing success, and at its regular meeting, Nov. 15, seven new members were elected. Commodious club rooms have been secured in Opera block to which members have access at all times. The leading electrical journals will be subscribed for, such as THE ELECTRICAL ENGINEER, *World*, *Review*, *Power*, *Scientific American*, *Power-Steam*, etc. The club gave the best stereopticon returns in the city on election night, which netted a snug sum for the treasury. The club has passed a resolution heartily endorsing the efforts of the Board of Trade to secure a first-class electric street railway system in the city. Mr. Herbert W. Eastman is secretary.

FRANKLIN ELECTRICAL SOCIETY.

AN informal reception will be held by the Franklin Electrical Society at Vienna Hall, Lexington avenue, near 58th street, on the evening of December 24.

PERSONAL.

MR. WM. H. PREECE, F. R. S.

The vacancy caused by the recent death of Mr. Edward Graves, chief engineer of the British Postal Telegraphs, has been filled by the appointment to that post of Mr. Wm. H. Preece, F. R. S. Mr. Preece has for many years been the chief electrician of the British Postal Telegraphs, and his appointment as engineer-in-chief and electrician is a well merited reward for intelligent service and honest work through many years. We extend to Mr. Preece our sincere congratulations.

Mr. J. H. Watermann, of the engineering force of the Westinghouse Company, who has charge of the installation of the new Woodland avenue line in Cleveland, Ohio, informs us that the road will be in operation in a very short time. Mr. Waterman's originality and skill as an engineer is shown in numerous ways throughout the installation and from present indications there is no doubt but that he will leave behind him a plant which, from station to rolling stock, will be a model in railway engineering.

OBITUARY.

MARMADUKE M. M. SLATTERY.

News comes from Fort Wayne, Ind., of the death there, suddenly, on Dec. 14, from hemorrhage of the lungs, of M. M. M. Slattery, the inventor and patentee of the Slattery alternating system and apparatus manufactured by the Fort Wayne Electric Company. Mr. Slattery, who was a native of Great Britain, was for many years actively engaged in the field of electric light and power. He became prominent about eight or nine years ago, when his name was coupled with many ingenious devices for cutting incandescent lamps into and out of arc circuits, and for giving greater flexibility and range to the incandescent system. Some of these devices were exploited by the Swift Electric Company. About that time the alternating method came to the front, and Mr. Slattery threw himself energetically upon work in that department, and the Fort Wayne Jenney Company put on the market a system bearing his name, complete in all the details required for that class of generation and supply. Mr. Slattery enjoyed the active support of Mr. R. T. McDonald, and the Fort Wayne Company soon became a dominant factor in the business, remaining so down to the present time, which finds it one of the allies or affiliated members of what is popularly known as the General Electric "Trust," its separate organization and activity being maintained.

Of late years, Mr. Slattery has been less prolific of inventions, but has busied himself with many ideas, one of which has been the use of storage batteries with street cars and tricycles. He was never very strong and has been in poor health for months past. He was a man of many acquaintances and of warm friendships, delighting not a little in social pleasures, and adding his share with a ready wit and a wonderful knack of mimicry. They who ever heard his definition of Electricity, delivered as an after dinner speech, are not likely to forget it.

PATENT NOTES.

TESLA'S SYSTEM OF MULTIPHASE DISTRIBUTION.

As is frequently the case, inventions are exploited and worked commercially before the issuance of the patents thereon, and not infrequently much injustice is done to the inventor by reason of the fact that the public is in ignorance of the date of the filing of the application. A striking instance of this character is the patent issued to Mr. Tesla on Dec. 13, 1892, No. 487,796, entitled "System of Electrical Transmission of Power."

While most of the features embodied in this patent are now well known in the art, the fact that the application was filed as far back as May 15, 1888, shows that even at that remarkably early date Mr. Tesla's ideas on the subject were clearly defined. The underlying principle embodied in this patent is to adapt the Tesla system to the type of alternating machinery now in general use. Thus there are described various methods of obtaining the required phase difference with ordinary multipolar alternators, by winding or coupling machines in various ways, together with other features whereby a single generator may run a number of motors either at the same speed as its own or all at different speeds.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED DECEMBER 6, 1892.

Alarms and Signals :—

Electric Bell, P. Wagner, New York, 487,437. Filed Oct, 3, 1891.

Has for its object to increase the striking force of electric bells and do away with the retaining spring.

Steam Boiler Indicator, G. L. McDermott, Neenah, Wis., 487,634. Filed July 26, 1892.

Electric Signaling Apparatus, M. Martin, Malden, Mass., 487,676. Filed Feb. 20, 1892.

Comprises a paper feeding train of wheelwork, and an electromagnet and armature controlled by the transmitting circuit combined with a circuit controller, one member of which is operated by the wheelwork and the other by the electromagnet.

Distribution :—

Apparatus for Distribution of Electricity, T. Tomlinson, London, 487,356. Filed May 25, 1891.

An automatic transformer system avoiding the necessity of employing an attendant at the sub station.

System of Electrical Distribution, O. B. Shallenberger, Rochester, 487,548. Filed Oct. 12, 1886.

Invention consists in employing several leads running to different converters and placing in each lead a regulating device.

Dynamos and Motors :—

Electric Motor, F. H. Beers, Newark, N. J., 487,242. Filed Feb. 26, 1892.

Claim :

A revolving armature, one field magnet pole arranged exteriorly to such armature and one field magnet pole mounted interiorly to such armature, the said field magnet poles being arranged on opposite sides of the axis of motion.

Connection for Commutators and Armature Wires, E. P. Warner, Chicago, Ill., 487,307. Filed March 5, 1892.

Provides ready means for attaching or detaching the wires to or from the commutator segments by means of a binding screw.

Connection Plate for Dynamos, J. J. Wood, Fort Wayne, Ind., 487,462. Filed April 18, 1892.

The line circuit and the exciting coils have their terminals fastened to terminal connectors constructed as fuse blocks and so arranged as to afford convenient access.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, J. L. Gethins, Boston, 487,824. Filed May 15, 1891.

Employs a copper electrode consisting of a cylindrical portion surrounding the sides of the porous cup and a plurality of radiating wings underneath the cup.

Heating:—

Electrical Heater, W. Mitchell, Malden, Mass., 487,285. Filed March 15, 1892.

A stove partly composed of magnetic material provided with studs having wire wound upon them.

Lamps and Appurtenances :—

Electric Arc Lamp, J. J. Wood, Fort Wayne, Ind., 487,315. Filed July 25, 1892.

Employs a feed clutch consisting of a sleeve embracing the feed rod, and a clutch lever pivoted to the sleeve having a brake shoe engaging the rod beneath its pivot.

Incandescent Electric Lamp, E. W. Applegate, Omaha, Neb., 487,360. Filed Feb. 29, 1892.

Provides means for repairing the filament without sacrificing the globe.

Incandescent Electric Lamp, G. A. Frei, Springfield, Mass., 487,477. Filed May 14, 1892.

Provides means for renewing the filaments of electric lamps and for securing a new filament to the leading in wire.

Mercurial Air Pump, G. A. Frei, Springfield, Mass., 487,478. Filed April 11, 1892.

Incandescent Electric Lamp, G. A. Frei, Springfield, Mass., 487,479. Filed April 11, 1892.

Has for its object to renew the lamp in case of the destruction of the filament by the substitution of certain parts only, and by persons not especially skilled in the art.

Metal Working :—

Method of Electric Welding, E. Thomson, Swampscott, Mass., 487,302. Filed Oct. 2, 1890.

Invention consists in making contact with both pieces to be united and passing a current of greater strength through one piece and then through the other.

Method of Arc and Incandescent Metal Heating, C. L. Coffin, Detroit, Mich. 487,607. Filed Aug. 6, 1892.

Consists of heating the material on one side by contact with the conductor in electrical connection with one terminal of the generator and on the other side by an electric arc.

Miscellaneous:—

Resistance Box, J. Waring, Manchester, Conn., 487,306, Filed April 28, 1892.

Comprises a bottom having a chamber for the resistance coils and a chamber for the contact plugs separated by insulation and having perforations in the top to coincide with the plug socket between the blocks.

Compass, P. J. Kaiser, Leyden Noordeinde, Netherlands, 487,330. Filed Feb. 11, 1891.

Jail, D. E. Osbourne, St. Paul, Minn., 487,448. Filed Aug. 6, 1892.

Electrical Device for Preventing Cribbing in Horses, G. W. Whitefield, Evanston, Ill., 487,461. Filed Sept. 4, 1891.

Thermostat, F. O. Elliott, Catawba, N. C., 487,519. Filed Aug. 20, 1892.

Process of and Apparatus for Generating Electricity, J. S. Rodgers, New York, 487,644. Filed April 14, 1892.

Consists in exposing a fusible electrolyte capable of being deoxidized and re-oxidized while in a state of fusion in the presence of suitable electrodes to a current of a deoxidizing gas injected in one direction, and a current of reoxidizing gas injected in the opposite direction.

Electro-Therapeutic Process and Apparatus, J. M. Wardel, Cadillac, Mich., 487,655. Filed Feb. 20, 1892.

An electric syringe.

Railways and Appliances :—

Electric Motor for Cars, C. A. Jackson, Reading, Mass., 487,329. Filed Aug. 3, 1891.

Provides means for changing the direction of rotation without stopping the motion.

Clamp for Electric Conductors, H. Lindahl, Chicago, Ill., 487,382. Filed Feb. 5, 1892.

A trolley clamp having a series of tongues on one plate and sockets on the other for additional security.

Closed Conduits for Electric Railways, A. A. Vanderpool, Newark, N. J., 487,654. Filed Mar. 18, 1890.

Employs an elastic closer for the slot of an electric conduit.

Telephones and Apparatus :—

Telephone Holder, E. C. Lewis, Woonsocket, R. I., 487,369. Filed Apr. 29, 1892.

AN IDEAL CENTRAL POWER STATION.

As we go to press we are in receipt of a copy of a paper by Messrs. C. J. Field and F. Bourne, read at the meeting of the Chicago Electric Club, on December 19. In their most excellent presentation of this important subject the authors assume a station having a capacity of 6,000 h. p. and consider first, the question of the unit of power to be adopted. This must, of course, depend largely on the ultimate capacity of the station, and in the case assumed a unit of 1,000 h. p. is adopted as the most economical. The authors then discuss the question of direct connection vs. belting and arrive at the conclusion that the former is to be preferred, one important consideration being the fact that a belted plant occupies twice the space of a direct-connected. The authors point out, however, that ample fly-wheel capacity is necessary in order to withstand the shocks caused by short circuits and sudden over-loading

The specifications for buildings and engines are then taken up. On the latter point the authors believe that the best results can be obtained by the adoption of a type of engine occupying a middle ground between the modern high speed and the Corliss engine, and combining the best features of both. The boilers and piping are also fully considered.

The generators, switchboards, and other electrical auxiliaries are then described, the authors giving the results of the best practice of to-day in operating large stations.

The paper contains much valuable information and we hope to print a fuller abstract in our next issue.

RULES RELATING TO ELECTRIC LIGHTING AND POWER SERVICE AT THE WORLD'S FAIR.—I.

The rules relating to electric lighting and power service at the World's Fair, as adopted by the national commission, are given below. These rules have not all been approved by the local committees, however, and are liable to change.

ELECTRICITY FOR INCANDESCENT LIGHTING SERVICE.

All state and territorial World's Fair boards, persons, firms or corporations who may desire to wire their respective buildings for the purpose of lighting same shall so install said wiring as to meet with the approval of the director of works before connections can be made with the main circuit.

All power service for generating light will be furnished during the exposition hours by the World's Columbian Exposition from the 1st of May to the 30th of October, 1893, at the rate of $8.00 per 16 candle power lamp capacity or the equivalent in lamps of other candle power. All changes in the location of lamps or appliances when once installed will be made subject to an extra charge, to be fixed and determined by the director-general and the director of works. The incandescent lighting circuit will be operated from 100 to 110 volt alternating circuits.

ELECTRICITY FOR POWER SERVICE.

First—All contracts to be made with exhibitors for power service shall be executed between said exhibitors, the director-general and the director of works, but the amount of power to be supplied to the exhibitor in each case shall be fixed and determined upon by the director-general.

Second—The electric motor shall be suitable to operate on a 500 volt constant potential circuit.

Third—The rheostat shall be constructed wholly of non-combustible material.

Fourth—The main line switch shall be of the knife blade type and suitable for working a 500 volt constant potential circuit.

Fifth—The motor shall be erected in position by and at the expense of the consumer and in a manner subject to the approval of the director-general and the director of works.

Sixth—The service connections to the motors shall be installed, maintained and owned by the World's Columbian Exposition.

Seventh—No service will be rendered for less than $20.00. Fractions of horse power will not be considered except for motors of less than 1 horse power.

Eighth—Charges will be made for service of connecting the main line at the following rates :

For ½ horse power and less.	$10.00	per horse power.
For 1 to 5 horse power..................	15.00	" "
For more than 5 horse power and not exceeding 10 horse-power............	12.00	" "
For more than 10 horse power............	10.00	" "

Ninth—Charges for service will be based upon the maximum mechanical horse power delivered to the motor, irrespective of the class of work to be operated by motor, at the following rates :

For ¼ horse power and less......	$20.00	per horse power.
For more than ¼ horse power and not exceeding ½ horse power	40.00	" "
For more than ½ horse power and not exceeding 1 horse power...............	75.00	" "
For more than 1 horse power and not exceeding 2 horse power...............	70.00	" "
For more than 2 horse power and not exceeding 3 horse power...............	60.00	" "
For more than 3 horse power............	60.00	" "

Tenth—Special service for motors not exceeding 2 horse power can be furnished on quarter phase alternating current circuit.

ELECTRICITY FOR ARC LIGHTING.

The aisles of the main building will be illuminated by arc lights free of expense to the exhibitor. A limited number of arc lights will be supplied for private lighting on the following basis, viz.:

First—The consumer shall pay the cost of wiring.

Second—The consumer shall pay for service from May 1 to October 30, 1893, at the rate of $60 per lamp of 2,000 nominal candle power.

Third—Lamps will be suspended from the ceiling and furnished with opalescent globes. If any special fixture is required, it shall be furnished by the consumer.

Fourth—All care and attendance to the lamps and circuits will be furnished by the World's Columbian Exposition without extra charge.

ELECTRICITY FOR CHARGING STORAGE BATTERIES.

First—The consumer shall provide lines and all material necessary from the local switchboard from which the current is to be distributed to storage batteries.

Second—The consumer shall provide all necessary labor and attendance connected with the charging or handling of the batteries.

Third—Current will be provided at 110 to 220 or 500 volts, at the rate of 10 cents per electrical horse power per hour.

ELECTRICITY FOR MISCELLANEOUS PURPOSES.

First—Electricity for special purposes will be subject to special agreement, to be determined at the time of making application therefor.

Second—Rates will be based either on those of power or those for storage battery purposes, according to the class of work to be performed.

QUEEN & CO.'S TESTING SETS.

Messrs. Queen & Co., Philadelphia, are meeting with great success in exploiting their standard portable testing sets.

One purchaser says :

> The portable testing set referred to has been in use constantly since we received it, and we find it to be first-class in every respect. Have used it on all kinds of work, for both high and low measurements, and think it is about as complete an instrument of the kind, as I have ever used.

Another writes :

> In answer to your inquiry under date of Nov. 21, would say that testing set No. T 805, marked 487, has given us most satisfactory results and we feel thoroughly satisfied with it in detail. It has won our confidence to the extent that we accept it as a standard, not only as a portable instrument, but in a greater share of our laboratory work and electrical measurements. It is correct to within a small degree, easily manipulated, and results quickly obtainable, and can say that we do not know of one single point left to be desired in this instrument for an instrument of this nature.

These instruments are made in a first-class manner, and are adapted for use under the most exacting conditions, such as in a manhole or close to dynamo machinery.

F. P. LITTLE & CO.

Messrs. F. P. Little & Co., of Buffalo, N. Y., have recently closed contracts as follows: a 10-light arc dynamo, and a 50-light incandescent dynamo, for the Atlas Oil Refining Company; a D-10 Thomson-Houston dynamo, set up complete, and 18–2,000 c. p. arc lights, for the East Buffalo Iron Works; and a D-7½ Thomson-Houston dynamo and Rice automatic engine for the planing mill of Messrs. Meyer & Metz. All the wiring and fitting is included in the last piece of work.

A LAMP AGENCY WANTED.

The firm of De Lew & Bailey, electrical and mechanical engineers, of 213 East Lombard street, Baltimore, Md., wish to secure the agency for an incandescent lamp of high efficiency and long life. The sole agency only will be considered.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

He who advertises is always in circuit.

THE RUSSELL AUTOMATIC SWITCH.

BY

Edward R. Grier

YOU may have a light in your hall and want to turn it on or off from your bed-room, from your vestibule, from your second-floor hall and even from more places; you may want to control all the lights from one place; you may wish to light your stable and hold the key to the situation under your own thumb; in fact there are a number of things you may wish to do and perhaps when you have read this article on the Russell Switch you will find it is the key to the unopened door of your desires.

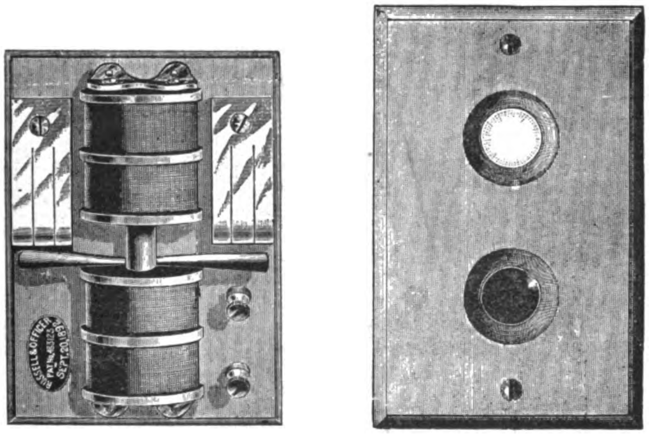
The illustration, Fig. 1, shows the switch—two spools of wire, a movable soft-iron core held by brass guides, a bar of copper extending at right angles, two sets of brushes, all mounted on a substantial porcelain or wood base.

The illustration, Fig. 2, is the push-button—two buttons, one black and one white, three points to connect your wires, same as the ordinary push-button used for automatic gas-burners. You may use as many of these push-buttons as you like and put them anywhere: all you need is No. 18 wire, the switch and the buttons—*no battery.*

You push the white button on any one of the pushes and instantly the little iron core is drawn into the centre of the spool to the right, engaging the copper bar in the meshes of the copper brushes, closing the circuit; touch the black button of any push and as quickly the circuit is opened.

The engraving, Fig. 3, shows the way to wire it. You notice two wires running parallel; these are the main wires. The switch is wired on the branch wires of the circuit which it is to control.

The wire A which is one side of the circuit connects to one binding-post of the brushes marked B, and a wire connected to the other binding-post D, continuing that side of the circuit, the switch being connected just as an ordinary single pole switch. The other side of the branch wire runs directly to the lamps—which in the diagram are shown as circles with little rays marked around them to assist in the conception. This is all there is to putting the switch in circuit and the buttons in circuit; the wiring is very simple.



FIGS. 1 AND 2.—THE RUSSELL AUTOMATIC SWITCH.

A button has three connections. A main connection under each push. Wire O, which is marked shunt, connects to the side of the branch wire which is not connected to the switch and runs to the main connection of the push. This wire can be extended to as many pushes as desired and its length does not interfere, as the resistance of this circuit is of no consequence.

From the connections under each of the black and white buttons a wire is extended to the switch, one connecting at E and one at G. The two binding-posts E and G are connected each to one of the spools of wire and the ends of the spools are connected to the binding-posts of the brushes.

When either button is pressed, closing the circuit, it makes a connection between the positive and negative side of the circuit and excites either one of the spools. This circuit is of high resistance but the great number of turns of wire on the spools give a strong magnetic pull, a pull equal to from seven to fifteen pounds according to the capacity of the switch, and the action is instantaneous. The amount of current required is small and the wires connecting the switch are only alive as long as the button is pressed.

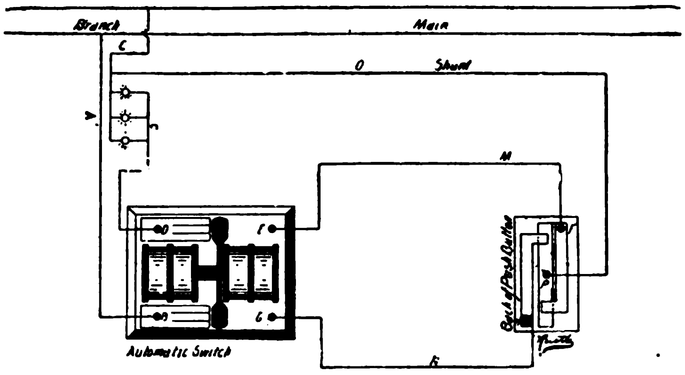


FIG. 3.—THE RUSSELL AUTOMATIC SWITCH.

Lights located in out-of-the-way places may be controlled by this switch and a great saving in wire can be made as the switch can be placed at the cut-out box and the branch circuit run direct to the lights, while only No. 18 wire need be run to the push-button. Not only can the amount of heavy wire be saved that would be required to run to an ordinary switch, but the size of the wire necessary for this circuit will be smaller because the length of the circuit will be reduced by the distance which would have been taken up by the switch loop.

DAILY SALES OF WESTINGHOUSE ENGINES.

MESSRS. WESTINGHOUSE, CHURCH, KERR & COMPANY have issued a list of their daily sales of engines during the month of October, showing a total of 98 engines having an aggregate of 7,525 h. p. One of these orders makes the 68th given by the same company. The engines are consigned to all parts of the earth, from Monterey to Moscow and intermediate points.

STEWARD'S LAVA INSULATION.

THE growth in popularity of the Lava insulation of the D. M. Steward Manufacturing Company of Chattanooga, Tenn., is very rapid, but not remarkable, in view of the excellence of the material. The company's orders are more numerous and larger than ever before in its history; and in fact the factory is pushed beyond its capacity in many directions.

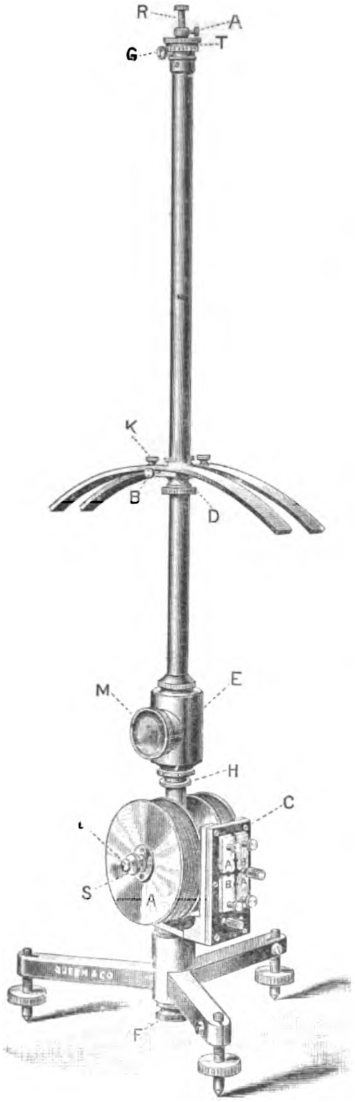
WARREN WEBSTER & CO.

THE good points of the "vacuum" feed water heater and purifier, manufactured by Messrs. Warren Webster & Co., of 491 N. Third street, Philadelphia, are fully set forth in the attractive 112-page catalogue recently issued by them. The pamphlet contains a detailed description of the heaters and purifiers, a partial list of those now using them, covering nine pages, and a large number of fac-simile letters that speak in the highest terms of the apparatus. A list of 33 new orders from all over the country received during the month of November constitutes a supplement to the catalogue.

SCHOOP'S GELATINE ELECTROLYTE FOR STORAGE-BATTERIES.

WE are informed that the Accumulatoren-Fabrik-Aktiengesellschaft, of Germany, has acquired the rights of Dr. Schoop's patent on gelatine electrolyte for storage batteries, for the entire continent of Europe. The tests of this material which have extended for a number of years, have demonstrated its excellent properties for storage-battery work, both in stationary and in portable installations.

QUEEN'S DEAD-BEAT REFLECTING GALVANOMETER.



Queen Dead-Beat Galvanometer.

The instrument illustrated herewith is a modification of the Weidemann galvanometer, and is adapted for both differential and direct work. The coils (A) are graded, having five changes of wire, and slip upon copper rods forming part of the damper.

Automatic connections are made with the binding posts on the switchboard (C) by means of small spring contacts upon the back of the board which press against platinized studs attached to the coils. By shifting plugs on the switchboard, the coils may be quickly connected in series, multiple, or differentially. To obtain perfect differential adjustment, a horizontal movement of the coils is secured by turning the micrometer screw (S).

The vertical tube is 24 inches long. The suspension being quartz fibre instead of cocoon silk, torsion is practically eliminated while great tensile strength is secured.

An essential feature of the apparatus is the arrangement of control magnet employed. In place of the usual single piece with the suspension tube passing through it, the magnet is divided into two parts, each of half the usual cross section, as illustrated.

The advantage of the construction is that should it be necessary to make very delicate observations in the vicinity of the instrument, the magnet may be temporarily removed without disturbing any adjustments, and then replaced in exactly the same position. Owing to the mass of copper in which the magnetic system moves, the galvanometer is almost absolutely dead-beat, and observations may be taken in rapid succession. This apparatus is of recent design, and placed on the market by Queen & Company, Philadelphia, from whom further particulars can be obtained.

"SALAMANDER" WIRE.

We have received from the Washburn & Moen Mfg. Co., a sample board illustrative of tests made with three leading makes of insulated wire, and one Salamander wire that had been subjected to the passage of 150 amperes for two minutes. The "Salamander" remains in fine condition; some of the others are very much like Mr. Krook, in Dickens's story, who disappeared and left only a dark grease spot behind. It is noticeable that the "Salamader" is also twisted in a knot and pulled tight. So far as the water-proof qualities go, it may be mentioned that the Massachusetts Electrical Engineering Co., of Boston, has made tests which show a resistance of 5,000 megohms and over, after submersion of the wire in salt water from six to ten days.

THE HUYETT & SMITH MANUFACTURING COMPANY.

As an earnest of the rapid increase in the number of their friends and customers the Huyett & Smith Mfg. Company, of Detroit, have issued a new 100-page catalogue descriptive of their apparatus as manufactured with their increased facilities which rapidly increasing orders made necessary. The company assert that there is no known problem for moving air that can not be economically solved by means of their apparatus. They are manufacturers of dry kilns, brick dryers, hot blast and ventilating apparatus, blowers, engines, boilers, dust separators, cotton fans, exhaust fans, steam traps, etc., and are constantly adding new apparatus to the list.

HEATING BY ELECTRICITY IN OTTAWA.

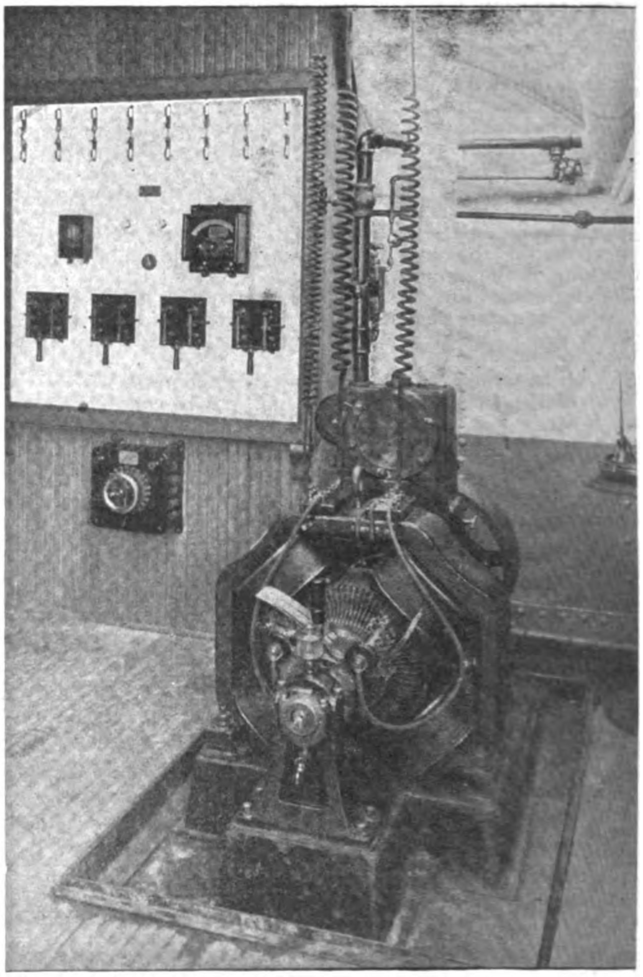
Mr. R. A. McCormack, a druggist at Ottawa, Can., is warming his store with Ahearn electric hot-water heaters. The water for the coils is contained in five heaters in the cellar, the total capacity being about 23 gallons. About 300 feet of pipe are used in the store, and the piping is divided into sections. The apparatus takes up about one quarter the space occupied by a furnace and boiler.

WOODBURY ENGINES.

The Stearns Manufacturing Company, Erie, Pa., builders of the Woodbury engines, report the shipment of a large number of engines recently—38 of the simple type, and three large tandem compounds. Of these, five engines were for manufacturing purposes, two for electric power uses, and the remainder for electric light plants.

LIGHTING THE WHALEBACK "PILLSBURY."

We illustrate on this page a very compact, combination, one-base plant for ship lighting. It is the first electrical plant ever placed upon a steamship of the whaleback type, and was installed on the "Pillsbury," when building at West Superior, Wis. Considerations of space entered largely into the question of this installation, and a small room, eight feet square, was all that could be spared. This precluded the employment of a belt connected plant, and a generating set of the General Electric Company type was therefore adopted.



The Lighting Plant of the Whaleback, "Pillsbury."

The dynamo, of the four pole type, is of 150 lights capacity, and is directly coupled to a fifteen horse power engine, both having a common bed-plate. Behind the engine and attached to the wall is the white marble incombustible switchboard. The dynamo room is located in the after portion of the vessel on the first lower deck. The vessel is wired in the usual manner for one hundred and fifty lights, the best grade of wire for marine purposes being employed. This installation, and that on the sister whaleback, the "Washburn," were effected by the Isolated Lighting Department of the Northwest General Electric Company.

NEW YORK NOTES.

Caldwell Water Tube Boiler.—The following are among recent orders for Caldwell water tube boilers, office 15 Cortlandt street, New York City: H. J. Hoerner & Company, Newark, N. J., 60 h. p.; Johnson R. R. Signal Company, Rahway, N. J., 120 h. p.; Polson Iron Works Company, Toronto, Ont., 984 h. p.; Norfolk, Albemarle & Atlantic R. R. Company (Princess Anne Hotel, Virginia Beach, Va.), 110 h. p.; Tiffany & Co., Jewelers, New York City (new factory Newark, N. J.), 103 h. p. The concern have secured, as selling agent, the services of Mr. P. M. McLaren, who for many years held a prominent position on the staff of the Babcock and Wilcox Company. The inventor, Mr. John A. Caldwell, has recently added important improvements, largely affecting the steaming capacity of this type of boiler, which is said to be attracting considerable attention from engineers. The company is also in the market with an entirely new departure in "Dry pipes" applicable to every boiler in use, and which is intended to prevent "flooding" of the engines under any circumstances. The Caldwell boiler and appliances are manufactured by the well-known firm of D. H. Burrell & Company, of Little Falls, N. Y., at their Poughkeepsie shops.

The Interior Conduit and Insulation Company, of New York, in order to meet the large and increasing demand for their product throughout the New England States, have found it necessary to provide a stock of their Interior Conduit and fittings, Lundell fan and power motors, etc., etc., to be carried in the city of Boston, and have appointed the well known firm of Pettingell-Andrews Co., of that city, as their sole agents for the States of New Hampshire, Vermont, Massachusetts, Connecticut and Rhode Island. This firm have enlarged and made alterations in their storerooms with the view of carrying a large and complete stock of the company's goods. The Interior Conduit Company have shipped them their first stock order consisting of some 200,000 feet of both plain and brass covered conduit tubing and junction boxes, couplings, elbows and other appliances in proportionate amounts. This, the latest move on the part of the Interior Conduit and Insulation Company, will doubtless be appreciated by the entire New England trade.

Mr. Edward E. Higgins, formerly the general manager of the Short Electric Railway Company, has opened an office at 35 Wall street, Mills Building, New York, as street railway consulting engineer and financial counsel. Mr. Higgins has been identified with street railway interests for several years, and his thorough knowledge of the business makes him an excellent adviser to intending purchasers.

PHILADELPHIA NOTES.

M. R. Muckle, Jr., & Co.—It is always a satisfaction to have customers return with their further orders, and Messrs. M. R. Muckle, Jr., & Co., are congratulating themselves on having sold a third plant to Mr. C. S. Garrett, the paper manufacturer. They sold him his first plant of a shunt-wound dynamo for his Keystone mill in West Philadelphia some five years ago, which was followed later by a compound-wound machine for his Marley mills in Maryland. They have now received an order for another compound-wound machine to be placed in the Beaver Dam mill at Beaver Dam, Pa. These are particularly interesting installations, as Mr. Garrett makes at his mills large quantities of the paper used for making the various kinds of hard fibre goods used so much for electrical work.

The Philadelphia Bank following the march of improvement has completely remodelled its handsome building on Chestnut street, and is putting up in connection therewith, a large office building. For the lighting of this new plant, Messrs. M. R. Muckle, Jr., & Co. are installing two 600-light dynamos and one 200-light dynamo which will be driven from engines of appropriate power by rope connection. The small plant will be used for all-night lighting, and the engine to which it is connected is being made of very large size in proportion to allow the carrying of a very low steam pressure by the night watchman. They are also wiring up the building for between twelve and thirteen hundred lights.

Queen & Company, of Philadelphia, are making a great drive with their Cardew Voltmeters, which they say are as reliable as ever, and guaranteed accurate to 1 per cent. Desiring to reduce the stock of these goods, which is unusually large, they announce a special cut in prices to hold good only until Jan. 1st. It will pay interested parties, especially central station managers, to correspond with them and secure a copy of circular No. 405, which gives further particulars.

The Standard Electric Company are receiving a large number of orders for their new time cut-out for arc and incandescent circuits. They will have a new double pole device ready for the market in about ten days.

The Helios Electric Company are greatly increasing their plant owing to the demand for the Helios arc lamp.

NEW ENGLAND NOTES.

The Jewell Belting Company, of Hartford, have recently made the following sales of their well-known dynamo belts:—Suburban Electric Light Company, Elizabeth, N. J., one 42-inch double; West Side Railroad Company, Elmira, N. Y., complete outfit of belts; United Electric Company, Springfield, Mass., one 24-inch double; Hudson Electric Light Company, Hoboken, N. J., one 48-inch double and complete outfit of belts; North New York Electric Light Company, New York, two 48-inch double belts; Thomson-Houston Electric Company, of New York, N. Y., one 58-inch three ply; Hartford Electric Light Company, Hartford, one 28-inch double; and Jersey City and Bergen Railroad Company, Jersey City, N. J., three 27-inch double.

Waterhouse, Gamble & Company of Hartford, Conn., formerly Waterhouse Brothers, have opened a new office at 45 Broadway, New York, under the management of Mr. Wm. T. Partridge, of that city. This firm has now associated with it Mr. James N. Gamble, of Cincinnati, O., and Mr. James T. Partridge, and has opened the New York office for the purpose of largely increasing its business. The Waterhouse arc lamp for arc and incandescent circuit has been well received, and has attained a most marked success, and now that Mr. Waterhouse has connected with him two such eminently successful business men as Messrs. Gamble and Partridge, a large increase in their business is expected and is sure to follow.

The Pettingell-Andrews Company, of Boston, have just been appointed exclusive agents in the States of Connecticut, Vermont, Massachusetts and Rhode Island, for the Interior Conduit and Insulation Company, of New York, and will hereafter carry a full line of their conduit and fittings for immediate supply. They will also act as agents in these States for the new Lundell power motors manufactured by the Interior Conduit Company. The Pettingell-Andrews Company recently bought out the entire stock of the Eastern Electric Supply Company, and are enlarging their electric railway and house goods department, in order to accommodate the unusually brisk demand for goods.

The Campbell Electrical Supply Company, of 104 High street, Boston, have just issued a new price-list of "Century" wires and products, having cancelled the contract with their agent for the manufacture of the "T. Z. R." wires. Their "Century" wires, which can now be purchased at first hands, are made according to the original formulas of the celebrated "T. Z. R." with important improvements recently made by Mr. Campbell, the original inventor.

The Berlin Iron Bridge Company, of East Berlin, Conn., have taken the contract for a new machine shop to be built at Newport News, Va., for E. C. Hillyer & Company. The building will be 82 feet in width, divided into a central portion 40 feet between crane girder columns, with a wing on each side 21 feet in width. The wings will be two stories high, the balcony floor being used for light work. The central portion of the building will be controlled by a 20-ton traveling crane.

The Beacon Vacuum Pump and Electrical Company, of Boston, are making a rather important announcement in their recent advertisements, in which they state that they have reduced the price of the Beacon 16 c. p. incandescent lamps to 35 cents, in lots of not less than 200. They state that they are enabled to make this reduction by the continued perfection of their special methods of manufacture, whereby they are enabled to make important savings, which they are willing to divide with their customers.

The Massachusetts Chemical Company, of Boston, manufacturers of Insullac, which has found favor with most electrical manufacturing companies, report that a recent test made on a large field coil wound with Insullac showed an insulation resistance of 23 megohms without leaking, a result which can hardly be achieved by using the ordinary shellacs.

The Shawmut Fuse Wire Company, of Boston, have, owing to the large increase in their business during the past few months, been forced to take larger quarters, and have removed to 161 High street, where they will have largely increased facilities for filling promptly all orders for tested fuse wire and links.

Mr. M. R. Neily, who was formerly connected with the Boston Electric Company, has commenced business under his own name, with headquarters at 10 Indiana Place, and has been awarded several good contracts for construction business.

Mr. Maybin W. Brown, 620 Atlantic avenue, Boston, has been appointed exclusive agent for Boston and suburban districts of the famous Salamander wire, manufactured by the Washburn and Moen Manufacturing Company of Worcester, Mass.

Mr. W. H. Francis, well known as one of the firm of Paine & Francis, not now in existence, has become connected with the Edison Electric Illuminating Company, of Boston, and will take charge of a special department.

Mr. F. R. Hart, of the Massachusetts Electrical Engineering Company, of Boston, has sailed for the United States of Colombia, where he will remain for a few months on business.

Google

WESTERN NOTES.

Mr. Edward H. Fox, Western agent of the Phœnix Glass Company, Ceylon Building, 19 and 21 Wabash avenue, corner Lake street, Chicago, has issued the following announcement to the trade: "Owing to the extensive increase in our designs and styles, we have found it necessary to open a salesroom in this city for the convenience of our Western trade. Our new styles of electric, gas and kerosene glassware, in cut, etched and colored, for 1892, are now ready, and will well repay an examination. The styles are new and novel and superior to anything before shown. I shall be at the rooms daily, from two to five o'clock p. m. until January 10. Other appointments can be made, if desired, by reasonable notification, the latter part of each month. I shall visit the trade in other cities as heretofore, and my residence in Chicago will enable me to call upon you often. I feel assured that it will be to your interest to call and examine our new lines."

Taylor, Goodhue & Ames have issued a very tastefully gotten up brochure regarding the Burton electric heaters, for which they are the selling agents. It is very attractively arranged showing the plan of wiring, pictures of the heaters, the Pullman double decked car equipped with same; gives some figures on the cost of operating and a number of very flattering testimonials. They also take occasion to quote the article which appeared in the The Electrical Engineer, July 29, 1892 on "Advances in Electric Heating," by W. R. B. Willcox, and give an extract of the report of the committee on Science and Arts of the Franklin Institute of Philadelphia on the Burton Electric Heater. It deals very thoroughly with the advantages of the Burton heaters and contains quite a fund of information regarding them.

Mr. John A. Grier, the well-known electrical and mechanical engineer of Philadelphia, has changed his residence to Chicago. He has equipped his home at Englewood with electricity in a very complete manner. Among the other novelties is a push button at the front door which lights up the newel post in the hall or puts it out. A double push upstairs also controls the newel post, operating a Russell automatic switch. A three-point switch in the hall turns on lights in both the upper and the lower hall and a three-point switch on the second floor controls the same lights. He has also fitted up a laboratory for experimental work, in his basement. His two sons, Mr. Thos. G. Grier and Edw. R. Grier are already well known in Chicago electrical circles.

The Hazelton Tripod Boiler Company, has made an assignment in the county court to the secretary of the company, Geo. W. Griffin, for the benefit of the creditors. Mr. C. Holmes, the well-known railway man, formerly president of the Chicago City Railway Company, is president of this company. It is stated by the attorneys that the assets are something like $65,000, while the liabilities are about $25,000. The direct cause of the assignment is a $1,500 judgment obtained in the United States Courts in favor of the Linden Steel Company of Pittsburg.

The Electrical Supply Company, Chicago, general Western agents for the Stanley transformers, have recently closed contracts for immediate delivery to one of the largest alternating stations in the West for 690 transformers, amounting to over $45,000. The Stanley transformers are to replace those at present in use, and the exchange was made on account of the small leakage current of the Stanley, showing a saving in operating expenses so great as to make it economical to throw out the old transformers and substitute new ones.

The Oliver P. Clay Company, Cleveland, Ohio, 51 Scranton avenue, are pushing their Baldwin soot suckers and vacuum boiler tube cleaners for electric light and railway plants, and name the following recent sales of soot suckers: Sioux City, Ia., Electric Company; LaPorte, Ind., Electric Company; Key West, Fla., Gas and Electric Light Company; Inter-State Complete Electric Construction Company, St. Louis, Mo.; South Bend, Ind., Electric Company. The literature disseminated by the concern is of the most amusing and convincing character.

Mr. D. H. Ogden, who is well known in electrical circles in the West has been appointed Western manager of the *Electrical World*, Mr. Fred De Land having resigned to go into other business. Mr. Ogden has been associated with electrical business for many years, having been with the Western Union Telegraph Company and later with the Bell Telephone Company as general manager of the Iowa systems. For the past two years he has been connected with the *Western Electrician*, during the latter part of the time as business manager.

The Electric Appliance Company have just rounded out their first business year, and report that the results have been highly satisfactory in every way. They will begin the new year by calling the attention of the trade to several recently acquired specialties of considerable interest. Their facilities have been increased in every direction, and the prospects of a heavy busines for the coming year are very flattering.

The Railway Equipment Company are extensively busy in all their lines of electric railway supplies. They have recently closed contracts for overhead equipment with the Sandusky, Huron and Milan electric street railways, the Webb City, Mo., electric railway and the Huntington, W. Va., railway. The demand for the Ahearn electric heating appliances is very brisk and increasing right along.

The Department of Electricity has been removed from the old offices in the Rand-McNally Building to the new quarters in the Electricity Building. The installation of the office was personally superintended by Prof. J. P. Barrett, assisted by secretary Hornsby. The work of the department will now be more vigorously pushed forward than ever and preparation for exhibits completed with despatch.

The Enterprise Electric Company are moving into their large new store, 307 Dearborn street, Chicago, having already outgrown their old quarters at 313 and 315. This is a good showing for the first six months. The company expect to meet with equal success, if not greater, in their new home and believe that their increased facilities will be a great element in their further growth.

Mr. R. Fleming, superintendent of the Rockford Electric Manufacturing Company, of Rockford, Ill., spent two or three days in Chicago last week on business for his company. Mr. Fleming reports being very busy and that the shop is running full-handed turning out the Rockford dynamos and motors.

"The Electric Spark" has been published under the auspices of the Electrical Supply Company for several months, but announces that the paper will be hereafter issued as an independent literary journal. A company has been incorporated with $25,000 capital to back the enterprise.

A. M. Morse & Co., St. Louis, among other recent sales have furnished a 300 h. p. cross compound condensing Buckeye engine to the Laclede Gas Company for their Mound street station, furnishing power for incandescent lighting.

In olden times the world looked to Athens for light—now Athens looks to Chicago for means of metering its light. Thus George Cutter interprets a recent order from Athens, Greece, for a batch of lamp-hour recorders.

The Russell Automatic Switch is meeting with success wherever it has been used. The architects of Denver at their recent exhibition, used the switch as a drawing card.

Mr. Geo. Cutter, The Rookery, Chicago, has been appointed agent for the porcelain specialties manufactured by Pass & Seymour of Syracuse.

CANADIAN NOTES.

The Royal Electric Company, of Montreal, has purchased an adjoining property of equal extent to the land occupied by its factory and station on Wellington street. It was the intention of the company to erect buildings upon this property, at once to be used as additions to the factory and station, but owing to the lateness of the season this has been postponed till next spring. The new station will be devoted to incandescent lighting, and will have a capacity of 50,000 lights to begin with, making, with the present stations, a total capacity of 125,000 incandescent lights, 1,500 arc lights, and 200 h. p. for power. Its equipment will consist of five 1,000 h. p. vertical compound engines, each belted to two 5,000 light alternators, designed by Mr. Fred Thomson, the electrician of the company. A special feature of these alternators is the embedding of the armature wire in the armature core so that no binding wires are required. An alternator similar to these is being constructed for the Ottawa Electric Light Company, of Ottawa, and a smaller one for the Quebec and Levis Electric Light Company, of Quebec.

The Quebec and Levis Electric Light Co. has purchased for $235,000 the entire water power of the Montmorency Falls together with the buildings and plant at present there. These falls, which are located about six miles in a direct line from the city of Quebec, have a descent of 260 feet and it is estimated will yield in the neighborhood of 18,000 h. p. Heretofore the company hired the portion of this power necessary to operate its station, but under the able management of Mr. S. Mohr, its business has increased to such an extent that more power was required, and in in order to secure this the entire water power of the falls was purchased. It is the intention of the company to erect a new power house and station and to fully utilize the power of the falls.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

VOL. XIV. DECEMBER 28 1892. No. 243.

INSULATION RESISTANCE OF COTTON AND SILK COVERED WIRES. [1]

BY

Thatcher T. P. Luquer, C.E.

AN enormous quantity of cotton covered and silk covered wire is used in the manufacture of dynamos, telegraph instruments and other electrical apparatus. Nevertheless, little or nothing has been published regarding the actual, or even comparative, insulating qualities of cotton and silk coverings. The great difference in the cost of, and space occupied by, cotton and silk coverings makes it very important to know their relative insulating value. In a similar way the difference between single and double cotton coverings in cost and space is also important.

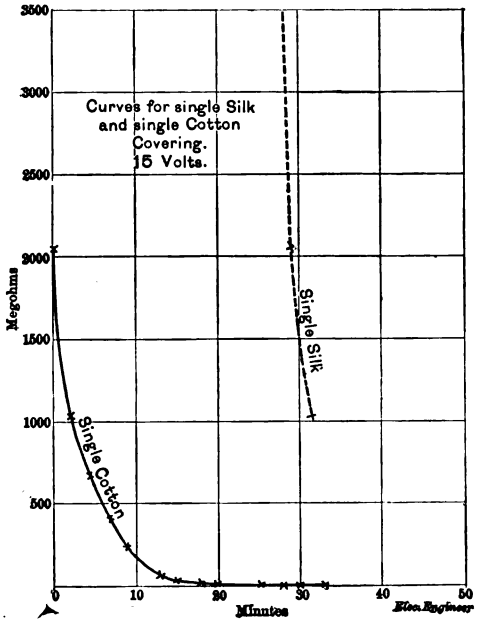


FIG. 1.

The kind of wire tested was that known as "magnet wire," consisting of copper wire covered with one or two layers of cotton or silk and called respectively "single" and "double" covered. The size of the wire itself in every test was No. 10 A. W. G., being .102 inch (102 mils) in diameter and the thickness of insulation (one side)

was .004 inch for single silk
" .005 " " " cotton
and .009 " " double "

The experiments consisted in making tests on the insulation resistance between two disconnected adjacent layers of wire wound on wooden spools 2 inches in diameter. The wire was wound on the spools on a lathe as evenly and with as uniform tension as possible. The coils were made 4 inches long. In order to observe the effect of shellac upon insulation, a spool of each kind of covered wire was treated with a coat of shellac between the two layers, and another coat over the outer layer. The spools having been wound with wire were baked in a drying oven at a temperature considerably above 212° F. for a time of about 2 hours, expelling in this way the moisture contained in the wood, wire covering, and shellac. The coils were then cooled in a bell jar to keep them from absorbing moisture. Both the plain and shellaced coils were thus treated.

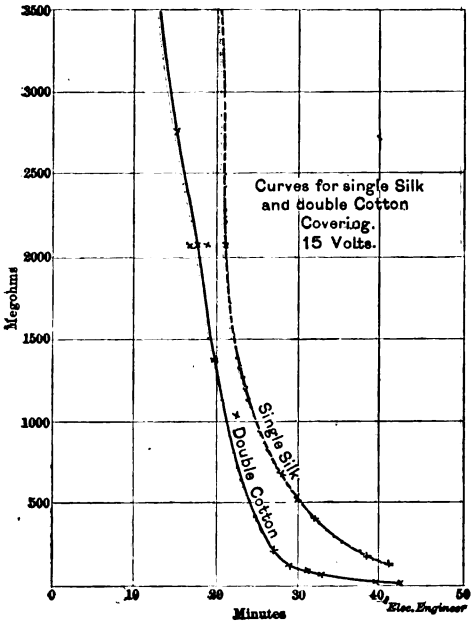


FIG. 2.

The coverings tested were single cotton, double cotton, and single silk. It seemed desirable, not only to determine the absolute difference in the insulation of the coverings, but also to observe the effect of moisture on the insulation

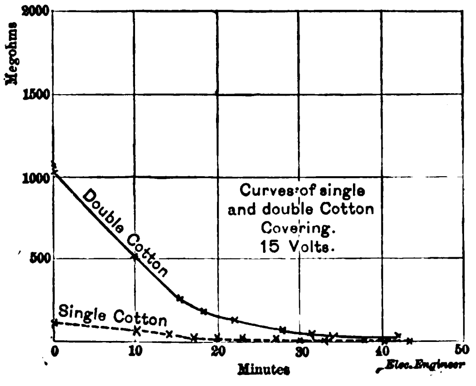


FIG. 3.

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[1] Electrical Engineering Thesis, Columbia College.

resistance of the different coverings, so that it might be determined whether one kind of covering was inherently better than the others, or whether its superiority was due to a smaller hygroscopic tendency.

In order to test the coils when affected by moisture, all tests were made with the coils placed under a bell jar containing a wet and dry bulb hygrometer for measuring the humidity, and provided with an inlet through which steam could be introduced at will.

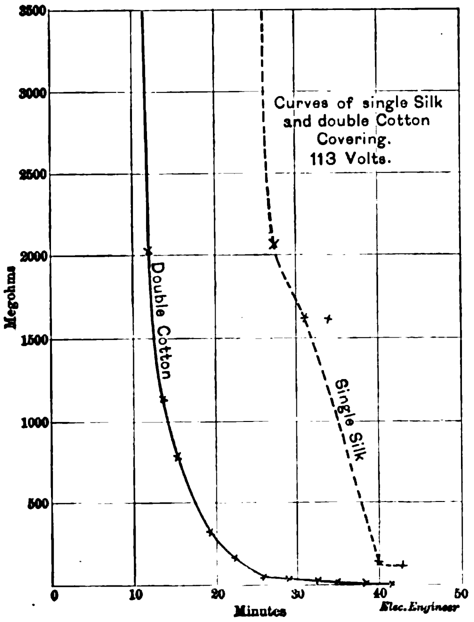


FIG. 4.

Each experiment consisted in testing, alternately, the insulation resistance of two different coils placed side by side under the bell jar. They were, therefore, always under similar conditions, even of varying humidity, and so it was determined to neglect the humidity in drawing curves to show the decrease of insulation resistance in moist air, and to use as the co-ordinates of the curves, the resistance and the time. As, however, the humidity had some effect on the rapidity of decrease of resistance the percentage of moisture in the bell jar was brought to a high point rapidly (about 98 per cent.) and then kept as constant as possible throughout the test.

The method used for measuring the insulation resistance was the ordinary one by direct deflection, using the following formula, which is condensed from the exact formula for this method by throwing out battery resistance, etc., which, in measuring megohms can be neglected.

$$X_{\text{meg.}} = \frac{\delta_R}{\delta_C} 10,$$

in which

$X_{\text{meg.}}$ = insulation resistance in megohms.

δ_R = galvanometer deflection for the known resistance of 100,000 ohms with 15 cells of chloride of silver battery and $\frac{1}{99}$ shunt.

δ_C = galvanometer deflection for the coil being tested with 15 cells of battery and no shunt.

If the $\frac{1}{9}$ shunt became necessary for use on the coil the result had to be divided by 10 and if the $\frac{1}{99}$ shunt became necessary the second member of the above formula had to be divided by 100. Some tests were made by using the electric light circuit of about 115 volts, putting the $\frac{1}{999}$ shunt on the galvanometer for 100,000 ohms, and putting 100,000 ohms in series with the circuit as a precaution against accident.

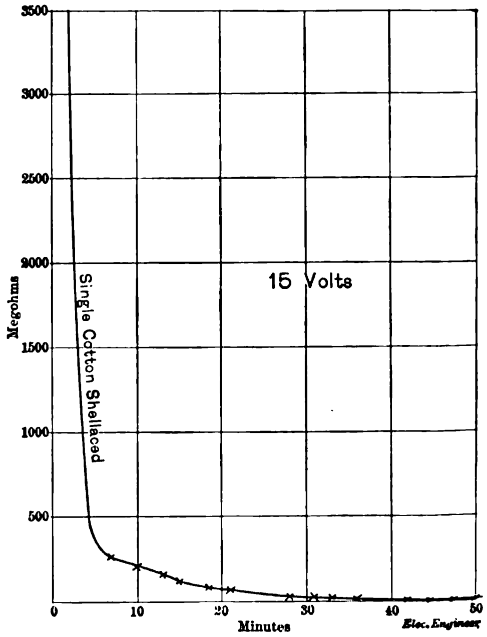
Each experiment is illustrated by a diagram giving the curves for the two coils tested. The curves on different diagrams cannot be strictly compared because the conditions of the coils in different experiments were not exactly similar. However, in order to connect the experiments the coils were interchanged, comparing each two coils in a separate experiment.

To proceed with a discussion of the experiments. Fig. 1 shows the difference between the insulation resistance of single cotton and and single silk coverings. The silk is seen, at once, to be far superior to the cotton, for even when dry the ratio of the resistance is as ∞ (practically) to 2,000 megohms. When moisture attacks the coils the cotton feels it at once, dropping rapidly and steadily, while the silk resists its effects for over half an hour, at which time the insulation of the cotton is low. When the insulation of the silk began to fail, it dropped rapidly, but the conditions then had ceased to be practical, the coils having been exposed for over half an hour to an atmosphere nearly saturated with moisture.

From this comparison I think we can draw the inference that, in the first place, silk is inherently better than cotton as an insulator, for both coverings were single and of very nearly exactly the same thickness, and all the conditions to which the coils were exposed were as nearly the same as possible; and in the second place, that moisture affects the insulation of cotton much sooner and to a greater extent than that of silk, owing, undoubtedly, to a much greater hygroscopic tendency in the cotton.

Fig. 2 shows the comparison between double cotton and single silk coverings. The effect of doubling the thickness of the cotton between the layers of wire is, as was to be expected, sufficient to greatly increase the effectiveness of the insulation, making it when dry about as good as silk. Moisture does not affect the insulation of the double cotton so soon or so greatly as in the case of single cotton (as shown in a following case) and the cotton curve compares quite favorably with the silk, considering the severe conditions of moisture imposed.

Fig. 3 shows the comparison between single and double cotton coverings. The initial resistances of the coverings are very low owing to the coils having been cooled in the air of the laboratory instead of under a bell lar, as in the case of the others. This defect in cooling was unavoidable, and no opportunity was found, unfortunately, to repeat the experiment. The value of these two particular



The Curve for Silk is a Line Parallel to the Axis of Time at an Infinite Distance (Practically.)

FIG. 5.

curves, for comparison of the one with the other is not, however, seriously impaired. We see, as before noted, that the double cotton is very much better than the single

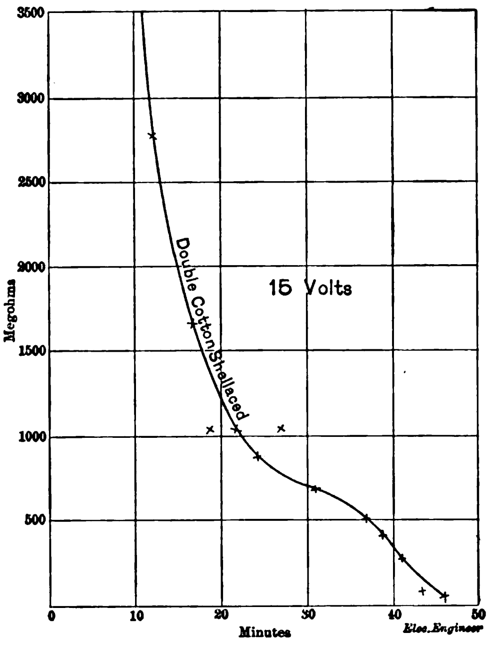


FIG. 6.

The Curve for Silk is a Line Parallel to the Axis of Time at an Infinite Distance (Practically).

cotton throughout the experiment, and shows more resistance to the effect of moisture than the single.

Fig. 4 shows a comparison of the curves for single silk and double cotton coverings subjected to the effect of 113 volts. We see that, when dry, the silk for this potential gives an insulation resistance of ∞ (practically), while the cotton, although very high, shows the effect of the strain and has a resistance of about 64,800 megohms. The cotton begins to feel the effect of moisture immediately, while the silk is apparently unaffected for over 15 minutes.

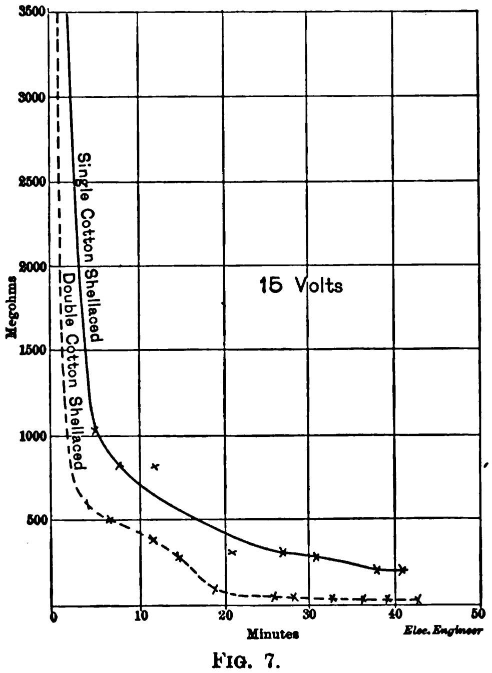


FIG. 7.

The cotton curve is regular, showing that the absorption of moisture goes on nearly uniformly, while the silk curve is erratic, the curve descending with jumps when steam is admitted to the bell jar, and absorption almost stopping at other times.

The conclusions that may be drawn from this first series of experiments are as follows:

1. Silk is inherently a much better insulator than cotton.
2. Silk is also a much better insulator than cotton because of its greater resistance to the effect of moisture, that is, it has a smaller hygroscopic tendency.
3. Double cotton covering is practically as good as single silk for ordinary voltages up to 120 volts, providing it is very dry. Subjected to the influence of moisture it fails more rapidly and to a greater extent than silk, but holds its own much better than single cotton.
4. Single cotton, even when dry, is a much poorer insulation than either silk or double cotton.
5. Silk still shows a good insulation resistance when, after half an hour's soaking in moist air, the cotton coverings have almost failed entirely.

We come now to the curves illustrating the experiments made on shellaced coils. Fig. 5 shows the curves for shellaced single silk and shellaced single cotton coverings. We see that, with the shellac to protect it from the moisture, the insulation resistance of the silk remains 8 (practically) throughout the test. The cotton, benefited to some extent by the shellac, starts with a better insulation resistance than before, but fails immediately and rapidly. The effect of the shellac on the cotton is simply to raise the curve throughout, but not to change its character.

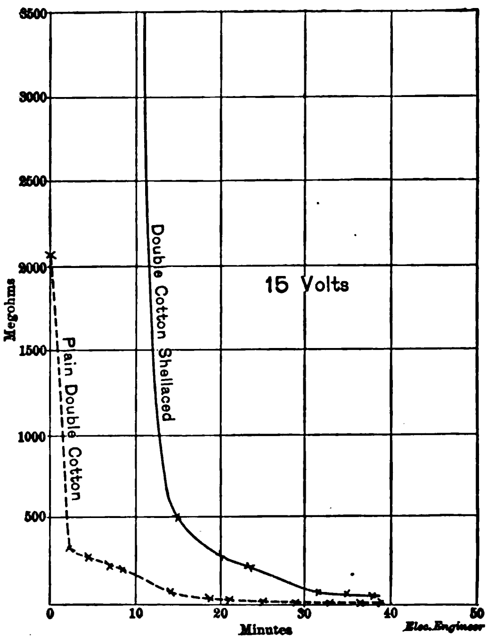


FIG. 8.

Fig. 6 gives the curves for shellaced silk and shellaced double cotton coverings. As in the preceding test the shellac enables the silk to show an insulation resistance of ∞ (practically) throughout the experiment. The cotton has an initial resistance of ∞ (practically,) and does not fail immediately. It is, however, affected and drops in the usual curve, only not as regularly or as much as without shellac.

Fig. 7 shows the comparison between shellaced single cotton and shellaced double cotton coverings. These coils had been kept rather longer after baking before being tested than in the other cases and, consequently, had absorbed a small amount of moisture, reducing the resistance of the double cotton coil from ∞ (practically) to somewhat over 4000 megohms. The comparison, however, is not impaired, as both cooled the same length of time and under the same conditions. As usual, the double cotton shows a better curve than the single cotton.

Fig. 8 shows the results of some experiments made directly to discover the effect of shellac on insulation, more particularly the comparison between double cotton shellaced and double cotton coverings unshellaced.

These curves show, in the first place, that shellac increases directly the insulation resistance of cotton, and in the second place that it helps the cotton to resist the effect of moisture to some extent by offering a barrier between the cotton and the moisture which breaks it down comparatively slowly. The conclusions that we may draw from the series of experiments on shellaced coils are :

1. Again the inherent superiority of silk compared with cotton as an insulator.
2. The continued superiority of double cotton over single cotton.
3. The apparent equality between double shellaced cotton and plain silk, as shown by comparing the silk curves in Figs. 1 and 2 with the cotton curves in Figs. 6 and 7.
4. Single cotton, plain or shellaced does not compare favorably with either double cotton or silk, plain or shellaced.
5. That shellac increases the insulation properties of both silk and cotton.

The experiments show that the insulation resistance of cotton, both single and double, diminishes under the strain of higher voltages (115 volts), while silk is not affected. The experiments also show that shellac enables cotton, apparently, to withstand the higher voltages under which, before, it showed signs of failure.

I have drawn conclusions in the preceding pages from what may seem, to some, rather insufficient data, but I feel justified in drawing those conclusions because all the experiments tend to corroborate each other, there being no conflict between the curves constructed under similar conditions. In conclusion, the results may be summed up as follows :

1. Silk, shellaced, is the best insulator.
2. Silk, plain, is probably the next best, and is very good, although only .004 inch thick.
3. Double cotton, shellaced, is practically as good as plain silk for use with voltages below 120 volts, and probably higher ; but double cotton is over twice the thickness (.009 inch) of single silk (.004 inch).
4. Double cotton, plain, is the next best insulator, and is good.
5. Single cotton, shellaced, comes next and is not so good.
6. Single cotton, plain, is poor, although thicker (.005 inch) than silk.
7. It is advisable to use shellac on all cotton covered wires, taking care to thoroughly dry the shellaced coil.

ENTITIES, MAGNITUDES, QUANTITIES AND UNITS.[1]

BY E. HOSPITALIER.

CONFRONTED by the ever growing invasion of scientific neologism, neologism which at first answered to a real need, for new ideas require new words and new definitions, it seems useful to offer a few considerations with the view of reaching an understanding respecting the principles which should govern the formation of the scientific language of the future, which it is to be hoped for the sake of posterity, will be more logical and coherent than the language of to-day. My readers will decide for themselves whether the considerations about to be presented will be useful in attaining the desired end: Unity in scientific terminology.

Entity which constitutes the being, the essence, the nature of a thing, is the first vague idea we have. When the idea of entity is acquired, that of magnitude, susceptible of increase or diminution soon completes it and from this, the idea of physical quantity follows. When the idea of physical quantities of the same kind but of different magnitudes is perfectly clear, then, and then only the unit appears, a quantity of a certain magnitude, serving as the common measure of magnitudes of all quantities of the same kind.

An example will better explain my meaning. The idea of the temperature entity is very old, but for a long time there was no precise idea of its magnitude. In a work published in 1542 in Venice, entitled, "Summa perfectionis Magisterii," is found the complaints of Geber as early as the eighth century, concerning the great difficulties which are met with in conducting operations at high temperatures because heat—the distinction between heat and temperature no longer exists—cannot be measured, *quoniam non est res ignis, quæ mensuari possit.* The physical temperature entity became a physical quantity only when the measurement of it was achieved by the invention of apparatus for comparison ; then followed the *units*, still more arbitrary and of an empiricism unworthy of the progress of science. What has just been said in relation to temperature has happened over again several times during a century in relation to the electrical entities. For each of them the idea of magnitude, then that of physical quantity, have preceded the idea of the *unit*, which came last of all.

The existence of a physical quantity is then independent of that of a unit of measure, and the idea of this unit came only after the clear idea of the quantity itself. There results from this that a physical quantity can be strictly defined only by bringing into its definition physical quantities, and physical quantities only.

The physical quantity is international, immutable in its essence, independent of the units of measure which are, on the contrary, national, varying according to the caprices of individuals and of governments. In defining each physical quantity without the units which are used as its common measure, its precision and its internationality is preserved, leaving each entirely free to choose the unit which is most convenient for each nation or for each application.

These important distinctions between an entity, a magnitude, a quantity and a unit, have a direct application in new definitions every time there is a new entity to be defined. We must not forget that the definition of a physical quantity is not deduced from its unit of measure, but, on the contrary, that the unit of measure is deduced from the definition of the physical quantity. The Congress of 1889 made an error of this kind, an error sanctioned by vote, in spite of my protestation, in relation to the *frequency of an alternating current.*

The English commit an analogous mistake by defining magnetic induction as the number of lines of force per cm.,[2] the French by defining the power of a machine, its work per second, etc. In acting thus, a physical quantity and a unit are associated; the product of this association is a hybrid, neither physical quantity nor unit, the least inconvenience of which is to completely falsify right ideas of the relations between physical quantities and to establish an inextricable confusion between physical quantities and the units which are used as their common measure.

For the same reason only the units of the quantities which define that quantity should enter into the definition of a unit of measure of a given quantity. Thus for example, the English persist in expressing specific resistances in ohms per cm.,[3] on the assumption that the specific resistance of a substance is the resistance of a cube of 1 cm. cross-section between two opposite faces. Specific resistance cannot be measured in ohms per cm.,[4] it is the product of a length and a resistance and should be measured in centimetre-ohms.

These general ideas are unfortunately almost always misunderstood, and this is the reason that we often see in the memoirs of learned societies of the highest reputation, velocities and accelerations in metres, specific resistance in ohms, etc.

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[1] From *L'Industrie Electrique*, Aug. 10, 1892. *Translated by F. R. C. Prescott.*

International congresses in my opinion would do a great and useful work in formulating once for all the general rules well stated; special definitions will be only the natural logical and systematic consequences, the application of which can be extended indefinitely in order to fulfil the new needs of the progress of science and the physical industries.

METHODS OF WIRING A BUILDING WITH CONDUIT.

BY

Paul C. Ascanyan

CERTAINLY so far as I know, no description has yet appeared in any electrical paper of the actual methods adopted in wiring one of the fine new modern office buildings, with the aid of conduit. This is a little singular, as conduit is already recognized as an indispensable feature by all our progressive and leading architects. With the object of giving an idea of the methods and practice now prevailing in this branch of the art, I venture to call the attention of the readers of THE ELECTRICAL ENGINEER to the work recently finished under my supervision in the Mills Building, San Francisco. I think the details will be found of general technical interest.

The Mills Building of San Francisco, is situated on the corner of Montgomery and Bush streets. It is thoroughly fire-proof, and is constructed of buff brick. It is ten stories high in the main building with an additional two stories above. It is 160 feet high with a frontage of 160 feet on Montgomery street and a depth of 140 feet on Bush street. It has some 420 rooms or offices, all of which are light and habitable, the inner ones being lighted by a spacious court in the centre of the building, the walls of which are of white glazed brick. There are about 2,100 outlets in the building, which supply some 3,200 lights. The supply of current is obtained from an isolated plant in the basement, which includes three No. 32 Edison machines. The conductors from these dynamos are polished copper rods, which cross the ceiling of the basement to the switchboard, located at the back of the engine-room and constructed of polished marble, presenting a fine appearance with its polished brass switches and instruments.

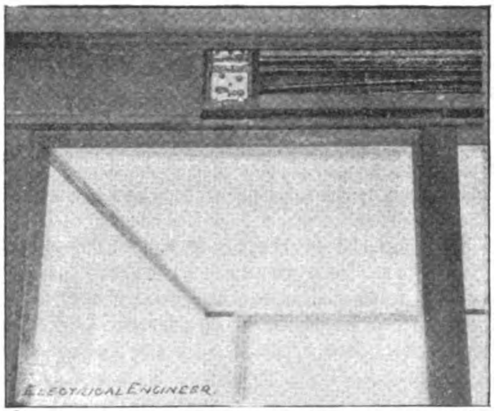

FIG. 1.

Running on the ceiling from the switchboard to the pipe shaft where they ascend are 24 tubes of one inch and one inch and a quarter inside diameter conduit which constitute the feeders for the building; two tubes feeding each floor and terminating in a cut-out box located in a toilet closet by the shaft. In these boxes are the switches and cut-outs which control the feeders for that floor, which are located in a space provided for them around the corridors on either side. These feeders, six in number, are ⅝ and ¾ inch inside diameter tubes. They are afterwards covered over with an oak moulding which constitutes the cornice and corresponds with the general interior finish of the building, of the style seen in Fig. 1.

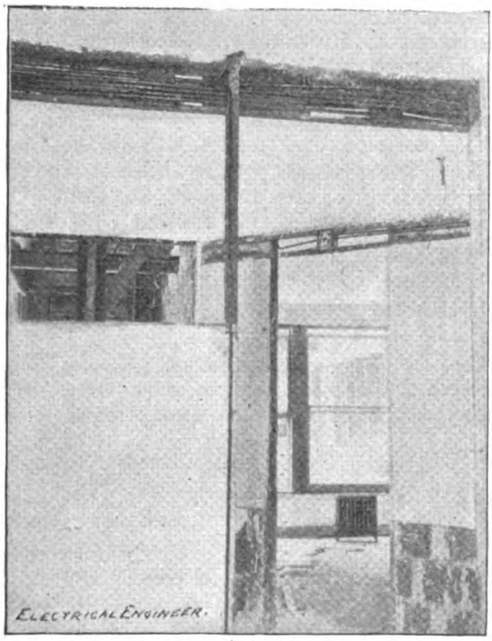

FIG. 2.

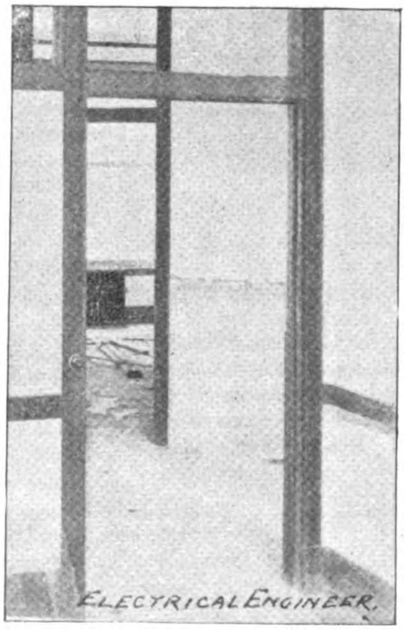

FIG. 3.

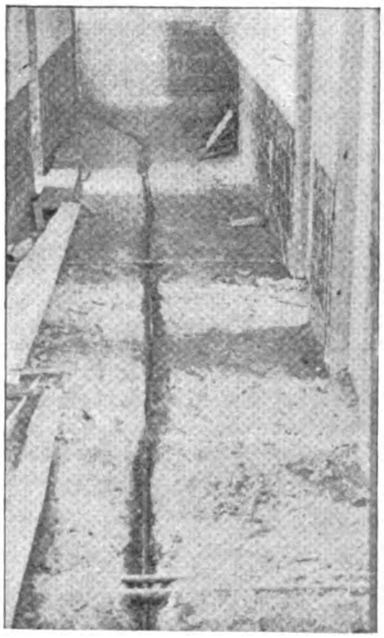

FIG. 4.

The mains which feed the offices are intersected by a cut-out, one of which is located in front of every office, Fig. 1, and is concealed behind a door in the cornice. From this cut-out the office circuit which is composed of ½ inch tube, coupled and telescoped within a ¾ inch conduit, ramifies. The room circuits are run above the tiling of the office they feed, Fig. 2, and run generally to a centre and two side outlets, being controlled by a switch conveniently located in the oak finish by the door as shown in Fig. 3.

The hall circuits are upon a separate system with all other public lights. They are also double tubes telescoped, and are fed through a cut-out located in a like manner behind the cornice shown in Fig. 2, to the left. These hall circuits are protected in the following manner: The earth and ashes used for deadening are removed from around the tube, which is then raised on small pieces of conduit laid crosswise beneath it. The space thus made, Fig. 4, is then filled in with plaster of paris, which forms a cheap and ample protection from acids and alkalies which might percolate through the cement, upon which a marble flooring is laid. The method of laying in a room is shown in Fig. 5. All tubes are held in place by patent metal clips and all joints are made with metal couplings corrugated and painted with P. & B. paint. The conduit employed is the black unarmored tubing made by the Interior Conduit & Insulation Company, of New York. In all some 18 miles consisting of ¼, ⅜, ⅝, ¾, 1 inch and 1¼ inch inside diameter tubes have been used. The wire used for branch circuits is the standard twin conductor of the Interior Conduit & Insulation Company, No. 14 B. & S. All mains and feeders are of flexible cable. No expense or trouble has been spared by the Edison General Electric Company of San Francisco to make this a fine conduit installation. It has been stated by experts that if a large enough crew were employed every wire in the building could be withdrawn and new ones inserted in less than ten minutes. The cost of wiring with the complete conduit system in this building was about the same as the cost for the Mills Building in New York, which was wired in the old manner with circuits laid in the plaster merely.

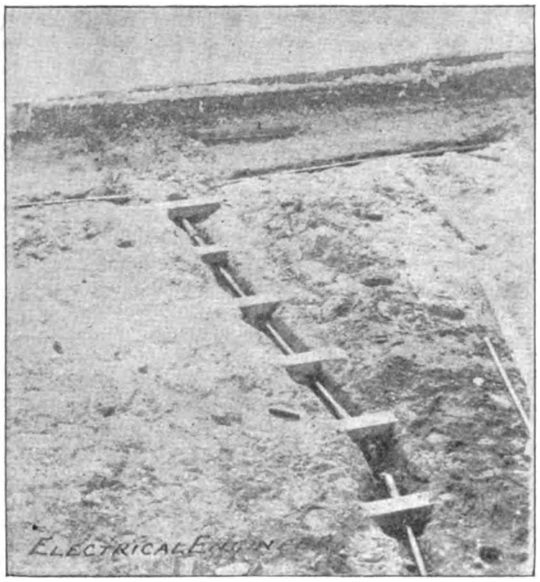

FIG. 5.

THE FRANKFORT EXHIBITION OF 1891.

THE managing committee of this exhibition recently issued its final financial statement. The total disbursements were $322,000, and the total receipts $346,000, thus leaving a balance profit of $24,000. Of this balance 15 per cent. was handed over to Herr Oscar von Miller, in accordance with his agreement; and the surplus was devoted to repaying subsidizers and exhibitors, the latter obtaining about 25 per cent. of the sums originally paid by them for space.

EMPIRICAL FORMULÆ FOR H-B CURVES OF MAGNETIZATION.

BY

Chas E Emery

THIS article is the outcome of a request by the editor of THE ELECTRICAL ENGINEER that the writer would, so far as possible, abridge Part II of his recent paper embracing the above subject,[1] and add some examples of the application of the formulæ.

Empirical formulæ for H-B curves of magnetization enable equations to be completed involving varying values of H or B, and thereby permit the application of the mathematical laws of maxima and minima, with all the important conditions of the problem included. Such formulæ also serve to correct errors in particular records by general comparison through the whole range of observations, and at the same time furnish a more ready and accurate means than arithmetical interpolations to obtain intermediate values really dependent upon complex functions. While many approximate formulæ have been suggested for the purpose, that of Frölich has been generally employed in the following form:[2]

$$(11) \qquad B = \frac{H}{a + b\,H}.$$

For ordinary magnetizations this equation, divided by B, gives the formula of Kennelly for the reluctance, but for high magnetizations H should be added to the second member of above equation, and the reluctance applies to the metallic induction.[3] The equation only contains two constants and can only be passed through any two points of a curve. It is frequently, therefore, unsatisfactory except near the points of application. Fig. 3 shows an application of this curve to Rowland's experiments, by substituting the reluctance constants (a = 0.0001, b = 0.000058), given by Kennelly, in Eq. 11, which shows that although the Frölich function shows no very great departure from the experimental curve within the limits illustrated, still the elements are quite different and the two curves are separating rapidly at the higher limit. One application is, however, made of the Frölich function by the writer, in the form following, to show the permeability μ as derived from Eq. 11, by dividing through by H.

$$(11a) \qquad \mu = \frac{10^{n}}{a + b\,H}.$$

The writer makes the applications in most cases to an equation of an hyperbola in the form (misprinted in the original.)

$$(15) \qquad B = c - \frac{a}{b + H}.$$

There being three constants in this equation, the resulting curve can be passed through any three points of any experimental curve, and greater accuracy obtained by applying the curve twice, once from near the origin to some definite point above the abrupt turn, and again for the remaining portion of the curve. It is found that the two curves thus obtained coincide practically for quite a little distance. No attempt has been made to apply the formula to the sharp bend near the origin marking the excitation necessary to cause the molecular magnets to turn toward approximate parallelism, but the application can commence at excitations of two to five, which is as low as is ordinarily required in practice.

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[1] The paper was read at the Chicago meeting of the American Institute of Electrical Engineers, and entitled "Rational and Empirical Formulæ Showing the Relation between the Exciting force (H) and the Resulting Magnetization (B)." See abstract of Part I, THE ELECTRICAL ENGINEER, Aug. 17, 1892).

[2] The equations and diagrams are numbered as they appear in the original paper.

[3] "Magnetic Reluctance." THE ELECTRICAL ENGINEER, June 15, 1892.

There is also one application of an equation of a straight line in the following form :

$$B = a + b\,H. \qquad (52)$$

The values of the constants for the various applications of the formulæ in the original paper are shown in Table O. Column 1 shows the numbers of the original equations and column 7 the numbers given herein of the equations showing the form of the function. In substituting the constants in either equation, the special values of H and B adapted thereto should be obtained from columns 4 and 5. The notation is explained by the headings of Table I.

The first application of Eq. 15 is made to experiments of Hopkinson on wrought iron, as stated in the well-known tables of S. P. Thompson. A number of these results are given in columns 7 and 9 of Table I. Column 8 of this table shows results obtained with a general formula on a rational basis, referred to in Part I of the author's paper.

A number of applications are made to results of experiments made under the direction of Dr. Nichols, at Cornell University, by Messrs. Thompson, Knight and Bacon, distinguished as the "Cornell" experiments.[4] These experiments show, what has probably been known to large manufacturers for some time, that some samples of steel either in the form of castings or plates, though showing less magnetism for low exciting forces than iron, really obtain a higher magnetization as the exciting forces are increased. A number of these curves are reproduced in Fig. 4 with the numbers in the original paper. The upper curve was however plotted from the Steinmetz experiments referred to below.

The quantities stated in Equations 18a and 18c for what is called a "compromise curve" are based, for the lower values, on the results obtained with mitis metal, Fig. 4, No. 22, while the higher values are made to correspond closely to those given by Hopkinson. This compromise curve provides for the fact that all samples of steel do not show higher magnetization than wrought iron, but always show lower results for low exciting forces. For ranges higher than shown by this formula, use Eqs. (17b) and (17d). Another compromise curve is given in Equations 18 f, g, h, i, based on Eq. 11a, from which results can be calculated even more readily than from an equation in the other form.

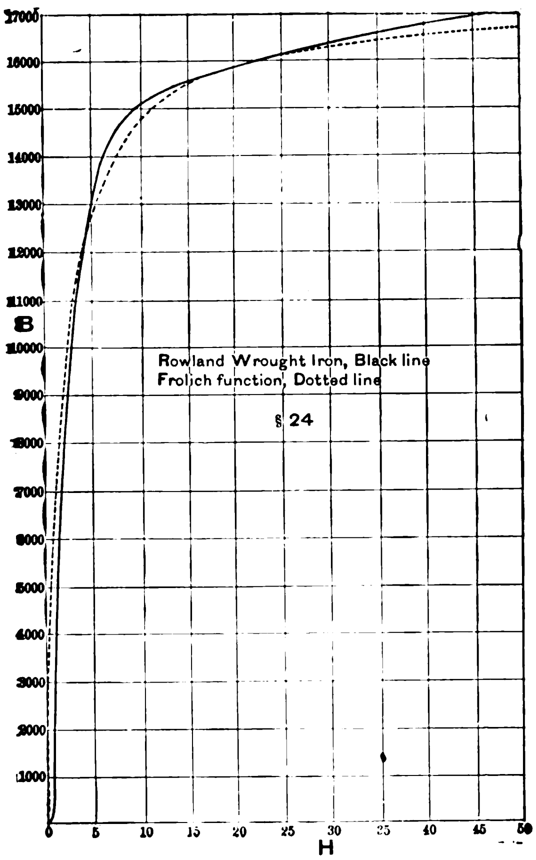

Fig. 3.

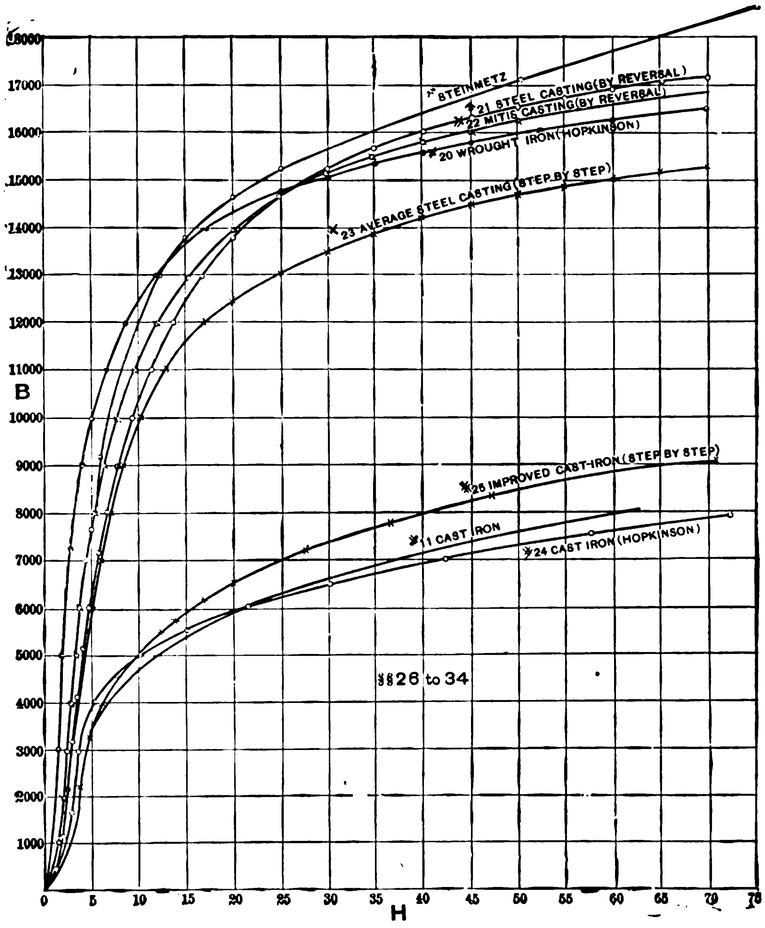

Fig. 4.

To show the application of these formulæ, let us suppose that for a current of 40 amperes a cross-section of field of 50 square inches and 500 series field turns have been provided ; that it is desirable to increase the field somewhat, and that the question arises which will best do it ; increasing the number of turns to 700 or increasing the cross-section of the field to 60 square inches. Referring to Table P, by dividing the number of turns (line 1) by the area (line 2) in each of the three cases, we obtain the number of turns per square inch (line 4); and multiplying these by the amperes (line 3) gives the ampere turns per square inch (line 5). If the field be of cast steel of best quality so as to equal wrought iron, and we select for illustration English instead of metric measure for use in this country, we may use Eq. (17d), Table O, as extending the range of Eq. (18c). Substituting the constants in Eq. (15) we have:

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[4] "The Magnetic Permeability of Special Irons for Electrical Purposes." By M. E. Thompson. Transactions of the American Institute of Electrical Engineers, June, 1892.

$$(70) \qquad B_2 = \overset{(c)}{134292} - \frac{\overset{(a)}{28108425}}{\underset{(b)}{603.06 + H_3}}$$

Adding the value of b from the equation to $H_3 = 400$ from column 4, Table P, we obtain at once 1003 as the divisor in the equation. A mere inspection of Barlow's tables of reciprocals gives as the reciprocal of 1003, 997 divided by 10^6. Pointing off six places from the value of a, we obtain 28.108 to be multiplied by 997, and the result subtracted from the value of c, at once gives $B_2 = 106268$, as per line 6, Table P. This, multiplied by the area, line 2, gives a field, F, in line 7, equal to nearly 5¼ millions of lines. Proceeding in the same way for columns 5 and 6 of Table P, we find for column 5 that 700 field turns with cross-section of field maintained constant only increases the field in round numbers to 5⅔ millions, or 7 per cent., as per line 8, but by retaining 500 turns and increasing the cross-area of the field to 60 square inches, as per column 6, it will be seen that the value of B_2 does not reduce nearly as rapidly as the section increases, so the total field is in round numbers 6¼ millions, or is increased 17.6 per cent., a result 10.6 per cent. better than that obtainable by increasing the number of turns. The values of the field given are of course the total field. The magnetic flux or flow across the armature, must be found therefrom by the law of the magnetic circuit in the customary way. The possible modification of this law referred to in Part I will be examined hereafter. The above example will show the applicability of the formulæ, and it is believed that the results will be found much more satisfactory than interpolations from tables, or attempts to measure small curves.

TABLE O.—VALUES OF CONSTANTS.

1	2	3	4	5	6	7	8	9	10	11
No. of equation.	Authority.	Material.	Result in terms of—	Exciting force in terms of—	Limiting values of quantities in Col. 5.	Equation in form of eq.	c	a	b	n
17 a	Hopkinson-Thompson.	Wrought iron.	B	H	1.66 to 52	15	16819	55656	3.049	....
17 b	"	"	B	H	52 to 666	15	20816	848915	117.5	....
17 c	"	"	B_2	H_3	8.5 to 267	15	108506	1842826	15.649	...
17 d	"	"	B_2	H_3	267 to 3420	15	134292	28108425	603.06	....
18 a	Cornell and Author.	Comp. iron and steel.	B	H	3 to 70	15	17868	102576	5.1165	....
18 c	"	"	B_2	H_3	14 to 350	15	115274	3396394	26.26	....
18 f	"	"	μ	H	6 to 105	11 a	......	3624	554.2	7
18 g	"	"	μ	H	105 to 184	11 a	......	80	5.132	5
18 h	"	"	μ	H_3	30 to 540	11 a	......	3624	108.	7
18 i	"	"	μ	H_3	540 to 943	11 a	.....	80	1.0	5
19 a	Cornell.	Average steel casting.	B	H	5 to 70	15	17035	124740	6.304	...
19 c	"	"	B_2	H_3	25 to 360	15	109900	4180266	32.3546	....
20 a	Hopkinson-Thompson.	Cast iron.	B	H	5 to 80	15	9572	164201	24.469	....
20 b	"	"	B	H	80 to 127	52	......	6300	21 3	....
20 c	"	"	B_2	H_3	25 to 400	15	61573	5436859	125.58	...
20 d	"	"	B_2	H_3	400 to 615	52	......	40644	26.774	...
21 a	Cornell and Author.	Comp. cast iron.	B	H	3 to 70	15	9960	168120	19.476	..
21 c	"	"	B_2	H_3	14 to 360	15	64385	5566621	99.9586	...

In the original paper, Table I showed the results of experiments made by Mr. Steinmetz on the permeability of wrought iron in connection with his experiments on hysteresis.[5] The second part of this paper[6], however, stated the results of other experiments with the same material, differing considerably from the first, and in discussing this paper the writer pointed out that neither series agreed closely with experiments made by others, the first series being too high for the higher magnetizations, as shown on Fig. 4, and the others too low. The Steinmetz experiments with steel castings recorded in the latter paper, however, agree very well with what are herein called "compromise"

TABLE P.—APPLICATION OF EQ (17 d).

1	2	3	4	5	6
1	t_f	Turns on field.	500	700	500
2	A	Cross area field, square inch.	50	50	60
3	C	Current. Amperes.	40	40	40
4	....	Turns per square inch.	10.0	14.0	8 33
5	H_3	Ampere turns per square inch.	400	760	333
6	B_2	Magnetization. Lines per sq. in.	106,268	113,660	104,166
7	F	$= A\,B_2$. Total field mag. lines.	5,313,400	5,683,000	6,249,960
8	....	Ratios	1.00	1.070	1.176

TABLE I.

Showing in different terms, the magnetomotive forces and resulting magnetizations of wrought iron and steel, in connection with experimental results of Steinmetz, Ewing and Hopkinson, and calculated values from empirical and general formulæ.

1	2	3	4	5	6	7	8	9
	$1.257\,H_1$	$6.4514\,H_1$	$8.109\,H_1$		$6.4514\,B$			
ELECTRIC EXCITING, OR MAGNETOMOTIVE FORCE.				MAGNETIZATION IN MAGNETIC LINES.		Exciting force.	MAGNETIZATION.	
Per square centimetre.		Per square inch.		Per sq. centimetre.	Per sq. inch.	GENERAL FORMULA (29) and (30)		THOMSON (see Table 2.)
Amp. turns. H_1	Mag. lines. H	Amp. turns. H_3	Mag. lines. H_3	STEINMETZ. Cast Steel.		Wrought Iron. Lines per square centimetre.		
				B	B_2	H	B	B_2
1	1.26	6.45	8.11					
2	2.51	12.90	16.22					
3	3.77	19.35	24.33					
4	5.03	25.81	32.44	7097	45786	5	10086	10000
5	6.29	32.26	40.55	8103	52276			
6	7.54	38.71	48.65	8949	57734			
7	8.80	45.16	56.76	9670	62385			
8	10.06	51.61	64.87	10292	66398			
9	11.31	58.06	72.98	10835	69901	12	12360	13000
10	12.57	64.51	81.09	11312	72978			
12	15.08	77.42	97.31	12111	78133			
14	17.60	90.32	113.5	12756	82294			
16	20.11	103.2	129.7	13286	85713			
18	22.63	116.1	146.0	13731	88584			
20	25.14	129.0	162.2	14109	91023			
25	31.43	161.3	202.7	14844	95765	28.5	14494	15000
30	37.71	193.5	243.3	15383	99242			
35	44.00	225.8	283.8	15791	101874			
40	50.28	258.1	324.4	16114	103958			
45	56.57	290.3	364.9	16374	105635			
50	62.85	322.6	405.5	16588	107016	52	16036	16000
55	69.14	354.8	446.0	16773	108209			
60	75.42	387.1	486.5	16923	109177			
65	81.71	419.3	527.1	17060	110061			
70	87.99	451.6	567.6	17182	110848			
75	94.28	483.9	608.2	17284	111506			
80	100.6	516.1	648.7	17373	112080			
85	106.9	548.4	689.3	17455	112609	105	17945	17000
90	113.1	580.6	729.8	17537	113138	200	19760	18000
399.3	502.	......	.....	18892	121880	502	21800	
797.1	1002.	......	.....	19541	126067	1003	22300	
EWING WROUGHT IRON.								
	1490	......	......	22650	.....	1490	22790	
2865	3600	18483	23232	24650	159027	3600	24900	
	8600	......	.....	30270	.....	8600	29900	
	19450	......	......	40820	......	19450	40750	

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5. See THE ELECTRICAL ENGINEER, January 27, 1892.

6. See THE ELECTRICAL ENGINEER, October 12, 1892.

curves, based on the Cornell experiments, modified by the writer to agree with iron for the higher values, and moreover Mr. Steinmetz has found that these results are well represented through a wide range by a modification of the Fröhlich function, which in the form and with the notation used in this article, explained in the headings of the tables, is given in Equation 71 below. Equation 72, referring to inch measurements is also added.

$$(71) \qquad B = 1.257\, H_1 + \frac{10^7\, H_1}{535\, H_1 + 3500}$$

$$(72) \qquad B_2 = 1.257\, H_2 + \frac{10^7\, H_2}{82.93\, H_2 + 3500}$$

The results given by the Steinmetz formula are shown in column 5, Table I, and the opportunity has been embraced to present a number of comparisons of various exciting forces and magnetizations stated in different terms. Equation 72 will of course give the results shown in column 6; except such slight variations as are due to dropping decimals in the constants. The results in column 5 from the Steinmetz formula will be found a little higher for low values of H and lower for the high values than the results of the Cornell experiments shown in Fig. 4. The Steinmetz experiments, therefore, do not show the superiority of steel for high magnetizations which appears from some of the Cornell experiments, but for this reason the formula is believed to be safe, like the compromise curves above given, as all samples of steel do not show this property. For $H_1 = 2{,}865$ the Steinmetz formula gives only 22,251 lines as compared with 24,650 found by Ewing for wrought iron, and the Steinmetz formula for average wrought iron is very much lower, giving only 20,790 lines.

WERNER VON SIEMENS.—BIOGRAPHICAL NOTES.

(From a Berlin Correspondent).

THE Atlantic Cable with the history of which the name of Werner von Siemens is so intimately connected has already given to the New World the news of the death of that great inventor and scientist. The black flag, and the imperial colors, at half mast, are flying over the factories at Charlottenburg and Berlin, but the whirr and hum of the machinery and the restless activity of that great industry which he helped to give the world goes on unceasingly.

Von Siemens died at his villa in the suburb of Charlottenburg, surrounded in his last hours by a large family circle. His 76th year would have been completed next week had it been his lot to have lived till then.

It is remarkable that his autobiography which was published only a few days ago should be quoted almost for the first time in his necrology. The modest story of his own life, the history of the development of his ideas (he hardly calls them inventions) will be a classic among the books of "Uncrowned Kings."

Werner von Siemens was, as the German press in their appreciative articles style him, a "self-made" man. The languages of this continent appear to have no expression for the phenomenon for they always use our word. "Self-made" men however are not alone the product of our Western civilization.

He was born in Lenthe near Hanover. His father was a farmer. At school in the Gymnasium of Lübeck he displayed a great talent for mathematics, and intended to become an architect. To this end he took private lessons in land surveying, but the necessary financial means for fitting himself for this calling not being at hand, he entered, at 18 years of age, the military service in the artillery.

In the Magdeburg garrison he attracted the attention of his superiors and was thereupon ordered to the Artillery and Engineering School at Berlin. Here he had some opportunities to lay the groundwork for his future researches. At the age of 2[illegible] he was ordered back again to Magdeburg where, in an improvised laboratory, he occupied the hours of an enforced leisure (he was confined in the fortress in consequence of a duel) in experimenting with galvanoplating. He took out his first patent on the results of this work.

His life as a young officer interfered with his efforts to follow his favorite studies, as he was transferred to the Wittenberg garrison, then to Spandau, and finally, in 1844, to the artillery workshops in Berlin. Then for the first time was Siemens enabled to connect himself with the scientific spirits of the time in Berlin, such as Helmholtz, Magnus, Brücke and du Bois-Reymond. At this time he met the mechanic, Halske, who helped him materially in the practical development of his ideas. During these years he was busy, among other things, with the measurement of speeds by the electric spark. He recognized, however, the great importance of the telegraph, and occupied himself largely in that direction, seeking especially the laws governing underground and submarine cables.

His first telegraph invention was an improvement in the Wheatstone instrument. In 1849, on the order of the Government, he built with entire success the first underground telegraph line from Berlin to Frankfort-on-the-Main, a distance of about 350 English miles. After preparing (in 1848) the harbor of Kiel with submarine mines provided with electric fuses (this was to prevent bombardment from the Danes) he retired from the military service and established with Halske the business which has assumed such enormous proportions.

Von Siemens was knighted by the old Emperor William. The present Emperor sent the family a telegram expressive of sympathy and high regard for the eminent work of the deceased. Empress Frederick and others of the royal family, also expressed their sympathy. The Electrotechnical Society, of Vienna, sent a delegation to attend the funeral.

Von Siemens leaves three sons, the two eldest of whom, Arnold and Wilhelm, have had the management of the business for some time past. The wife of Mr. Arnold Siemens is the daughter of Helmholtz. The late Sir William Siemens in London was a brother of the deceased. It was principally with Sir William and Frederick, another brother living in Dresden, that the well-known "Regenerative Principle" was developed by the deceased.

Hardly less known than the other brothers is a fourth, Karl Siemens, who stands at the head of the St. Petersburg firm of Siemens Brothers. The latter firm was established in 1850, and has supplied all Russia with the telegraph.

Siemens was present at the Frankfort Electrical Exhibition in 1891, during the Congress week.

The works of Siemens & Halske at Berlin are devoted to the manufacture of telephones, telegraphs, signals and other small apparatus, while the dynamos and other heavy work are made at the extensive works in the suburb of Charlottenburg.

December 7th, 1892.

AN ELECTRIC MAIL SYSTEM BETWEEN NEW YORK AND BROOKLYN.

THE U. S. Post Office Department has made arrangements to test the mail handling system of the Automatic Dispatch Company, between the cities. The plan which the department has agreed to test is the invention of Mr. A. Bryson, Jr., and is to be operated by the Automatic Dispatch Company, 12 Broadway, N. Y., of which G. M. Mudge is president and Oscar C. Wheeler is secretary. The transportation will be done by a miniature trolley railway, enclosed in a 16 inch square conduit. The mail matter will be placed in carriers of steel wire, four feet long and fourteen inches square, each carrier taking a pouch containing 3,000 faced and assorted letters, or an equal bulk of other classes of mail. In the end of each carrier or car is a small electric motor, taking the current from a wire running between the tracks. It is expected that the cars will run from office to office in about five minutes, and keep up an incessant delivery to and fro. The cutting off of power and all switching will be done automatically, so that the clerks at either end will merely have to load and start the cars. The conduits, if the present plans are carried out, will be suspended from the iron work of the bridge and of the elevated road on Adams street, Brooklyn. The company has agreed to assume all cost in this experiment. Mr. Bryson is now securing patents on some of the details, and is unwilling to exhibit his drawings at present.

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VOL. XIV. NEW YORK, DECEMBER 28, 1892. No. 243.

Those who take part in the endowment of research are the truest and greatest of modern philanthropists.—Professor R. H. Thurston.

COMBINATION STATIONS.

MORE than one paper has been read before the National Electric Light Association by members advocating the consolidation of electric light and railway enterprises in the same town, at least so far as the generation of electric current is concerned; and very many arguments of a convincing nature have been brought forward to show the economies which can be attained by such a pooling of interests. But, strange as it may seem, the suggestions thus thrown out seem to have been acted upon in but a very few instances. The reason for this may probably be sought for in the fact that in the discussions thus far carried on the figures given were very general and indefinite, based upon more or less assumed conditions, thus lacking the weight of arguments which are accompanied by facts and figures drawn from actual practice. This state of affairs, however, ought no longer to exist, and both electric light and railway managers will, we are certain, be deeply interested in the article from the pen of Mr. H. K. McCay, which appears in our electric railway department in this issue.

Mr. McCay shows some remarkable results in economy with combined stations for arc and incandescent lighting and railway power service; but as they are taken from actual practice no other conclusion can be derived than that there is here a legitimate field for the operation of the electrical financier,—a field almost as great as that open to him in the days of early electric lighting companies. The economy to be gained in such joint operation must in the end accrue to the benefit of the public at large as well as to the profit of the stockholders of the electrical enterprises concerned. There may be instances in which the consolidation of interests, the advantages of which are so clearly pointed out by Mr. McCay, may be impracticable, but exceptions are few, and we are certain that in a large majority of cities with companies now maintaining independent lighting and railway power stations, the joint operation of apparatus can be effected with large economy. There are to-day 400 American cities with a population over 8,000 inhabitants and below 100,000. In each of these the combination plant should prevail.

THE VITAL IMPORTANCE OF ARMATURE INSULATION.

THE complaint that the American Institute of Electrical Engineers has been rather too mathematical of late in some of its papers, and hence has damped the ardor with which members have attended the meetings, may have some element of truth in it. On the other hand, there have been several valuable practical papers lately, and none more so than that read last week on the use of micanite in armature insulation. We cannot imagine a better use for the Institute than these opportunities to discuss what promise to be very important advances in the art. If more of the commercial innovations could be thus submitted promptly to technical scrutiny and discussion on the open floor, we think the science and art would be a great gainer.

Without armature insulation, we should have no current. The armature in the dynamo is the heart of the electric distribution service of to-day, and any defect in it must react on the entire external system. How to maintain the normal, continuous working of this heart or electrical pump, if we may be allowed to carry out the analogy, is a subject which has very properly claimed the serious attention of dynamo builders from the start. Aside from mechanical considerations it was soon learned that the insulation of the armature must be maintained intact if trouble is to be avoided; and if this was observed early in the art with low tension direct current machines, how much more must it be considered a vital factor in these days of high tension alternating currents. It was well, therefore, that the subject was brought to the attention of electrical engineers. We believe it is now generally conceded that for purposes of armature insulation there is nothing which approaches mica, but its expense has thus far prohibited its use except in commutator work and in high tension alternating machines. The search for a true substitute for mica has thus far met with as little success, comparatively, as that long continued quest for a substitute for platinum in incandescent lamps. But where Nature has been chary in her supply, man's ingenuity has come to the aid of the dynamo builder by utilizing what had heretofore been a waste product. The new product, micanite, described by Mr. E. P. Thompson, appears to have all the properties of its original constituent and will no doubt prove a valuable adjunct to the materials of electrical engineering.

In this connection we would also call attention to the extremely valuable paper of Mr. T. T. P. Luquer, in which the relative insulating powers of cotton and silk, with and without shellac, are well brought out, in this issue.

ELECTRIC RAILWAY DEPARTMENT.

ON THE OPERATION OF ELECTRIC LIGHT AND RAILWAY PLANTS FROM THE SAME STATION.

BY

A. K. McCay.

At the beginning of the present year there were some half dozen electric light and railway plants owned and operated by the same corporations and from a common central station. Having had charge of one of these plants for over a year, I wish to bring to the public notice and to the notice of investors the eminent fitness and the extreme economy of operation under this system. Many railways rent their power from light companies, paying as high as $2.75 per car per day, and as low as $1.75. What I wish to show is that the cost for power in such a consolidation as above is far less than the lowest figure, and the consolidation of these interests even in small places from ten to twenty-five thousand inhabitants, may be made to pay handsome dividends to the investor. The figures I give are based on the records of these plants, and while they represent no one of the plants referred to, either in operating expenses or receipts, any one familiar with the operating expenses of a railway or light station will see they are not far wrong. We will assume the station to have average monthly receipts as follows:—

Railway, 5 cars	$2400.00
Arc lights, 125 at $8.80 per month	1100.00
Incandescent, 1300-16 c. p.	1100.00
Total monthly receipts	$4600.00

I will enumerate the expenses under four general heads. First, we will take the general expenses. This will include all expense which is common to the three branches, railway, incandescent and arc. Therefore, such expenses as coal, oil, water, labor at station, and office expenses, will all have to be summed up and apportioned to the respective business, in proportion to the amount of horse power used by that branch. After this general expense has been so divided, it is then added to the expenses which are not common to all branches; but which appertain to and are attendant on the separate branches of railway, arc and incandescent light work. It has been observed that the month of March most nearly approximates a mean for the whole year, and in my estimates below I have, as nearly as I could, taken averages for that month:—

GENERAL EXPENSES PER MONTH.

3 Engineers, $60, $60, $80	$200.00
2 Firemen	90.00
1 Cleaner	40.00
Coal	500.00
Water	30.00
Oil and waste	40.00
Repairs to engines, boilers, etc.	60.00
Office expenses including rent, ins., etc.	250.00
	$1200.00

ARC LIGHTS.

Trimmers	$100.00	
Carbons	80.00	
Arc lamp and machine repairs	70.00	
Line repairs	50.00	
		$300.00

INCANDESCENT LIGHTS.

Lamps	$75.00	
Linemen	75.00	
Repairs to line and machine	50.00	
		200.00
Total		$1700.00

RAILWAY OPERATION.

12 Conductors and motormen at $3.25	$1170.00	
Oil and waste	20.00	
Repairs	50.00	
Armature winder and two cleaners	160.00	
Superintendent	100.00	
		1500.00
Grand total expenses per month		$3200.00

The incandescent load varies from 100 to 500 amperes. Average 200 amperes for 24 hours' run.

$$\frac{200 \times 220}{746} = 55 \text{ H. P.}$$

55 x 24 =	1320 H. P. Hours.
5 cars 15 hours run at 10 h. p. apiece equal to 50 x 15 =	750 H. P. Hours.
105-1200 c. p. arc lamps for 12 hours at 100 x 12 equal to	1200 H. P. Hours.
Total H. P. Hours for Station	3270

Incandescent equal 3/8 General Expenses very nearly.
Arc " 3/8 " " " "
Railway " 1/4 " " " "

			Receipts.
Therefore Railway expense	300 + 1500 =	$1800	$2400
Incandescent,	450 + 200 =	650	1100
Arc,	450 + 300 =	750	1100
		$3200	$4600
			3200
Net receipts per month			$1400

Assuming that each car consumes an average horse power of 10, during a run of 15 hours, as has been shown above, we get 15 x 10 equal to 150 h. p. hours for one car or 750 for all five cars. The actual cost for power (being compiled from the General Expense less the net salaries) in estimate is:

$$\frac{\$950}{4} = \$237.50, \text{ as railway is } \tfrac{1}{4} \text{ of General Expense.}$$

$$\frac{\$235}{30} = \$7.85 \text{ for five cars, or } \$1.57 \text{ for one car.}$$

Assume each car operates 100 miles. Cost per mile 1.57 cents. This is low, as the cost of power given by the West End Company in their reports averages 7.65 cents per car mile. At Buffalo and elsewhere it is much less. Cost of power in South London Subway 5.20 cents. This gives a cost less than $\frac{1}{3}$ of the smallest of these figures. Now as to the incandescent lights, suppose we have 1300 connected 16-c. p. lamps. The average load we have assumed is 800 lights or 200 x 2 x 2 x24 = equals 19200 lamp hours per day or 19200 x 30 = 576,000 lamp hours per month. The total cost of this is $650. This gives $\frac{65,000}{756,000} \times 10 = \frac{650}{756}$ mills per lamp hour $\frac{86}{100} =$ of a mill.

Some time ago I had charge of one of the most economically operated and best paying incandescent stations in the country. I found then if I could get the cost per lamp hour down to four mills the profit would be large provided of course the lamps connected and the load were heavy. So we see that the combination reduces the cost of operating the incandescent lights to one-fourth.

Now let us look at the arc lights. 125 arc lights, 1,200 c. p., take very nearly 100 h. p. at 12 hours average, equal 1,200 h. p. hours or 125 x 12 = 1,500 lamp hours. 1,500 lamp hours x 30 equal 45,000 lamp hours per month. Total cost $750 or $\frac{75}{45} = \frac{15}{9} = 1\frac{2}{3}$ cents per lamp hour. This is also an extremely low figure for the arc lamps.

It may be said that I have assumed too low an estimate of expenses, but I have the actual figures at my hand, and I am at least 15 per cent. above the true expenses of the companies referred to. Suppose now we look at the original cost of such a plant as I have indicated above. We will take a railroad five miles in length with five cars and everything in place to cost somewhere near $75,000.

Incandescent station and pole line; station large enough for all and capacity of 3,000 16-c. p. lamps	$70,000
Arc light plant,	30,000
	$175,000
	06 per ct.
	$10,500
Net revenue as shown from actual practical experience to be	$14,500
Year's surplus,	$4,000

This is only given as an example. If the management is pushing, active, and energetic, the net revenue should be very easily $20,000 per year. The business would gain year by year, the cost per car mile would be reduced; the cost per lamp hour both for arc and incandescent service would reduce, and, in my opinion, based on actual experience and from knowledge of what other plants are doing, this combination of interests is one of the most profitable that can be made. It is the next thing to come in commercial electrical development.

LIGHTNING ARRESTERS FOR STREET RAILWAY CIRCUITS.

BY

William A. Turbayne

There seems to be an erroneous idea among some manufacturers of lightning arresters as to the form of arrester best suited for the protection of street railway motors and apparatus. It is well known that the most suitable form for such work would be that in which electromagnets or solenoids are entirely eliminated, on account of the high resistance offered to the lightning discharge, and the impedance is certainly high when magnetic coils are used in the discharge circuit, whether they contain an iron core or not; the iron core, of course, serves to intensify the effect, although the self-induction in the convolutions themselves is enough to render the arrester unreliable.

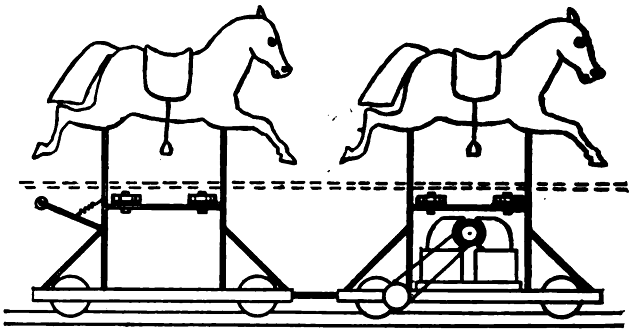
Were the insulation on the field magnet and armature cores sufficient to withstand the excessively high tension static discharge, then the above described arrester might prove effective, as offering the only practicable path to ground; but as such is not the case, then the only other paths to earth would be through the motor windings; but on account of their exceedingly high reactive effect, the discharge must necessarily break through some weak point, in all probability between the armature windings and core, and force its way to earth through the framework, at the probable expense of the armature.

It is thus evident that a great deal depends upon the arrester for the protection of the apparatus and great care should be bestowed thereon. If electromagnets were used in their construction it would be advisable to place a non-inductive resistance or a pair of discharge points, as a shunt to the magnet coils, the static discharge preferably taking that path, although the following dynamic current would flow through the low resistance magnet and perform its proper function. In a lightning arrester designed by the writer some two years ago, a succession of fuses were automatically placed in circuit as the one previous melted and several good forms working on the above principle are now on the market, as well as many other efficient and novel forms. But to place in the discharge circuit of an electric railway system an arrester containing a pure and simple electromagnet or solenoid, without even a non-inductive shunt, would surely seem to be an unpardonable sin, and one which would undoubtedly have been punishable by death if committed during the existence of the strict laws of the Medes and Persians.

AN ELECTRIC RACE-TRACK.

BY L. M. PINOLET.

At Sohmer Park, an out-door amusement resort in the city of Montreal, an electric race-track, suggested by the one at the Frankfort Electrical Exhibition of 1891, has been constructed according to plans furnished by the inventor, Mr. A. Sallé, of Paris. It consists of an oval wooden platform about 150 feet long by 100 feet wide and 4 feet above the ground. Extending around the platform is an oval track, some 30 feet in width, divided into eight parallel courses upon each of which are two large hobby-horses coupled together, one close behind the other. These horses are propelled by electric motors around the track along their particular courses, the movements and speed of each pair being under the control of an operator stationed in a small building at one side of the track. Each pair of horses—moving independently of its neighbors—seems to be taking part in a real trial of speed. At one moment a certain pair is ahead, then another takes the lead, who may in turn be passed by some other horse, and so on, thus affording the excitement and amusement of an actual race to both riders and spectators. The horses are mounted upon trucks, which are under the platform, by means of two upright iron bars fastened and braced to the front and rear ends of each truck. The truck consists of an oblong iron frame provided with two wheels, one before the other, as in a bicycle. These wheels have double flanges to permit them to run on a circular or oval single-rail track laid upon the ground beneath the platform. There are eight of these tracks, corresponding to the eight parallel courses, extending around the platform about three feet apart and equidistant from one another, over each of which is a continuous slot in the platform for the upright bars to pass through. To the lower side of the platform are attached square wooden beams placed end to end so as to form continuous rows on both sides of every slot. These rows are parallel to the slots at a distance of 4 or 5 inches from them. At such a height as to be a little below the platform, the upright bars of each truck are connected by a horizontal iron bar, at opposite ends of which are two iron wheels whose axles are vertical and supported by studs on the bar. These wheels are of such a diameter as to fit loosely between the rows of beams, which serve as guides to keep the horses in an upright position, and prevent the upright bars from coming in contact with the edges of the slots.



An Electric Race-Track.

Upon each circular track there are two trucks coupled together. Upon the foremost of each pair is an ordinary 2½ h. p. series electric motor, which drives one of the truck-wheels by means of a single reduction gearing connected with its pulley by a belt. Current is conveyed to the motors by copper wires fastened to the lower side of the platform, contact being made by an ordinary trolley-wheel, mounted on a short arm, and the rails are used for the return. A 100-volt shunt-wound generator supplies the current.

The speed of any individual motor is independently controlled by a rheostat in its particular circuit, by means of which it can also be started or stopped. In addition, the speed of all the motors in a body is regulated by varying the current supplied to them from the dynamo by means of a rheostat in its field circuit. The switches, rheostats and other apparatus are located in the operator's house. The speed of the motors is regulated so that the horses move at a rate of about nine miles per hour which has been found to be the most suitable speed.

The trolleys are placed on the rear trucks, so that in case a coupling between two trucks should break, the supply of current to the motor would be cut off and both trucks would stop, thus avoiding the possibility of one truck continuing its course alone around the track till it overtook and collided with the other.

This plant was manufactured and installed by the Royal Electric Company of Montreal, under the superintendence of Mr. Lewis Burran, of that company, to whom the credit is due of important modifications which materially improved the working of the apparatus.

MISCELLANEOUS.

THE USE OF 500-VOLT MOTORS.

We are glad to say that the subject of 500-volt motors, lately discussed in these columns continues to attract attention. We are in receipt of further communications of interest on this point. Mr. A. D. Newton, of the Eddy Electric Manufacturing Company writes us: "The advantage of 500-volts for power circuits has been appreciated by a great many power companies and we are selling a great many motors for use on those circuits. We give you here a list of some of the cities that we are dealing with for this voltage. Boston, Lowell, Utica, Newark, N. J., Pittsburgh, Cincinnati, Chattanooga, New Orleans, St. Joseph, Omaha, St. Paul, Chicago, Portland, Ore., Atlanta, Waterbury, Conn., Providence, Buffalo, Quincy, Ill, Burlington, Ia."

Mr. C. Kammeyer, of the Jenney Electric Motor Company of Indianapolis writes: "Regarding 500-volt motors we can say that we find the use of such motors increasing steadily, nearly half of our inquiries and orders being for generators and motors of that voltage. We never could see any good reason why 500-volt apparatus should not be used more extensively than it has been in the past. With improved methods of manufacture and a past experience as regards insulation, etc., their operation should now give little or no trouble, and the advantages over the use of machines of lower tension are enormous. We hope to see the day when direct current apparatus of even 1,000-volts pressure will be as much in use and demand as 110 or 220-volt apparatus is now."

Mr. J. W. Wilshire, president and treasurer of the Card Electric Motor & Dynamo Company of Cincinnati, O., says: "We have been building our motors very successfully for 500-volt circuit, for the past year or more, and have now in use, in this city and near vicinity about 235 motors for 500-volt circuit, aggregating about 925 h. p., and in every case where these high voltage motors are in use, they have given splendid satisfaction. We have not had the slightest trouble with one single machine that we have installed. In fact we find that the best circuit for commercial use in regular power work, is the high voltage constant potential circuit, and nearly all that we are installing now are on either the 220 or 500-volt circuit."

Mr. F. A. Scheffler, superintendent of the Brush Electric Company, Cleveland writes us: "In regard to 500-volt motors for light and power circuits, we would state that we can only agree most heartily with you in your views in reference to such a system, and would add that we are making quite a number of 500-volt motors to run on constant potential circuit. We have also made a quite a number of motors and generators to operate upon 1,000-volt circuits, some of the latter being used at the Calumet & Hecla mines, where we have five 75 h. p., such motors operating in the mines, at varying depths, underground, from 800 to 4,800 feet.

"At Montgomery, Al., we are putting in a large plant for arc lighting and alternating incandescence system; also a 500-volt power circuit system, with generator, switchboard and some motors to run from this circuit.

"This, we feel, is only the beginning of what will grow into an extensive business, especially, where parties have extra power to spare, or where water power can be had in large quantities and at small expense."

TRANSFORMER TESTS.[1]

Dr. Fleming's paper on "Experimental Researches on Alternating Current Transformers," read before the Institution of Electrical Engineers on the 24th ult., is a monument of painstaking experimenting. It will occupy about a hundred pages of the Journal of the Institution, and bristles with data of tests of different transformers. Dr. Fleming's results are generally beyond any suspicion of inaccuracy, and the enormous labor involved has been well spent as it definitely settles several important points. In the first place it explodes the fallacy that the iron losses are reduced at full load. Of course, the loss goes down to a minute extent because the induction is slightly less, but it was thought in many quarters that it went down to a very small fraction of its "no-load" value. This fallacy was due to the use of complicated and inaccurate methods of measurement, and never had any real vitality, so we shall probably hear no more of it. This point had also been made quite clear by Messrs. Ayrton & Sumpner in the meantime, and Dr. Hopkinson and his son had also made tests of a Westinghouse transformer. Dr. Sumpner had devised a special method of testing to get accurate results at full load. Another point Dr. Fleming has settled is that the wattmeter is perfectly accurate. Mr. Swinburne has advocated the use of the wattmeter for the last five years, and has been generally ridiculed on this point. He would now be able to laugh at his opponents if his firm had not provided Dr. Fleming with a wattmeter which was inaccurate, and has subsequently been replaced. It is, however, a considerable relief for those who did not know it before, to realize that the efficiency of a transformer can be found in a few minutes, by means of a single instrument, and that three voltmeters, three ampere-meters, split dynamometer, and calorimeter methods are all unnecessary complication.

The next point to determine was whether the open or the closed circuit was the better. Dr. Fleming has certainly shown with unassailable accuracy that the "Hedgehog" transformer sent him had nowhere near the efficiency claimed for it by its inventor. Why a transformer with so little copper loss and so little iron should absorb so much power in proportion it is a little difficult to explain. There will, no doubt, be an interesting discussion on this paper.

AN INSURANCE MEETING ON THE PACIFIC SLOPE.

A conference committee meeting, consisting of a special committee of the San Francisco Chapter of the American Institute of Architects, of the California Electrical Society, with Geo. P. Low, as representative of the Pacific Insurance Union, was held in the rooms of the Fire Underwriters' Association of the Pacific, San Francisco, on the evening of Nov. 23, for the purpose of discussing the subject-matter of a paper prepared by Mr. Low for the October meeting of the Underwriters' Association, on "Electrical Impostors" and of devising means by which the ideas contained therein may be enforced. The organization of the meeting was effected through the election of Mr. Low as chairman, with H. T. Bestor, editor of the *California Architect*, as secretary. As the result of the deliberations, a resolution was adopted requesting the committee of the California Electrical Society to prepare a general set of specifications under which accessible wiring may be placed, and also to prepare a second set of specifications under which the wiring at present countenanced by safety requirements, and which is considered safe if properly inspected, may be placed. These specifications, when drafted, are to be submitted to the architects for consideration and revision, when they will be again returned to the conference meeting and formally adopted. It was the sense of the majority of the meeting that it would be inadvisable to endeavor to effect a radical change in existing methods of electrical construction, especially so in localities under the surveillance of an electrical inspector. Hence, the resolution proposes to countenance ordinary methods of wiring, as defined by existing insurance requirements, in any instance where same can be inspected by some electrician in good standing. This will necessitate the organization of an electrical exchange on the Pacific coast similar in its nature to the New England Electrical exchange. The meeting adjourned subject to the call of the chair.

MICANITE AND ITS APPLICATION TO ARMATURE INSULATION.[1]

BY EDWARD P. THOMPSON, M. E., FOR CHARLES W. JEFFERSON AND ARTHUR H. S. DYER.

An armature and its commutator consists of the combination of two elements, namely, electric and magnetic conductors and insulators. In the earlier days of armatures, the electrical and mechanical dimensions and proportions of the conductors were considered of prime importance. The first armatures were small and the electromotive force low, and consequently little attention, comparatively, was given to the element, insulation. Lately, simply paper, cloth, convolutions of ligatures, or these materials impregnated with shellac or similar insulating varnish or paint were employed for the purpose of preventing leakage or short circuit. To remove the solvent of the shellac, the armatures were baked for twenty-four hours. Judging from the variety of materials used at present, and the changes from one material to another, it would seem that the insulators are now receiving their share of consideration, while the core, wires, commutator sections and other conducting portions are secondary details. Why so much difficulty with armature insulators and so little with other insulators, such as line insulators? Because, in the former, not only must the material be of extremely high resistance, but also unaltered under the effects of heat and must be crowded into very small quarters. Space must be economized. If the electric current or heat alone were present, and if space were not so much limited, the problem would be easily solved. It yet remains to be proved that any known substance is absolutely a non-conductor

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[1] *Industries.*

[1] Read before the American Institute of Electrical Engineers, New York, December 21st, 1892.

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—nor is the resistance of a given conductor constant. Unfortunately for the armature constructor, the worse the conductor the less the resistance with increase of temperature. An extra current is produced in metals upon variations of current. A diminishing of current occurs when first entering a substance of high resistance. Finally and gradually the current becomes constant. This action for convenience is often called polarization. As this property is noticeable only in long lengths of the insulating material, it has little bearing upon any of the armature elements other than in connection with the covering of the wires. The substance possessing the property of polarization in a marked degree is gutta-percha.

Paper or fabrics by themselves, should never be used as an insulator, because when moist they conduct a current so well that they may properly be termed semi-conductors. A coating of shellac or oil upon almost any substance enormously increases its resistance, and protects porous and deliquescent substances from water. Paper thus covered serves, with machines of low electromotive force, the purpose of preventing leakage, but, by no means, perfectly in practice with large machines. Its advantages are more in the nature of convenience and cheapness than of efficiency.

Paper which has been thoroughly dried is of very much higher resistance—so high that it falls under the head of non-conductors, and therefore, the shellacs should not be applied until after the paper has been subjected to a thorough drying process.

It is a peculiar property that a given substance in a compact condition is of very marked higher resistance than when powdered or comminuted; for example, pulverized glass is a semi-conductor, while sheet glass is as high in resistance as silk. This property has been noticeable in armature practice. If the insulating material is cracked here and there, it is unfit for armature use. The cracks are in the nature of interstices between the particles of a powder, and at the cracks the material is in part ground. The explanation may lie in the distinction that the pulverized material has more surface, or that damp air exists in the spaces between the particles, or that a spark can traverse a gas better than a solid, or that each particle becomes coated with a film of moisture. The last seems the most probable, because the best surface concentrators of water usually exhibit the property most strongly.

The locations of insulation in an armature are between the armature disks to prevent eddy and Foucault currents; between the core and the windings to prevent the current from short-circuiting the coils through the core and burning out the armature; between the commutator sections to prevent leakage from one coil to another; over projections or in grooves in the core; and around the wire to guide the current in convolutions. All these parts, even in the best made armatures become more or less abnormally hot. Means have been planned and sometimes put into practice for cooling the parts, and thereby saving the insulation. One method consists in constructing the armature after the style of a fan or with large radiating surface; another, in equipping a device to blow out the sparks at the commutator, and again, in using cooling insulating liquids. With whatever precautionary means the machine is equipped, the parts, either accidentally or through inefficiency of means, will become abnormally hot. The machine will be injured if combustible materials form the bulk of the insulator. The materials of an ideal armature consist of copper, iron and a heat-proof and waterproof non-conductor. If the material is combustible, or altered in its chemical nature, by heat, its resistance is changed and generally lowered. Manufacturers of incandescent lamp filaments know that complete carbonization cannot take place except at a very high temperature, like 3,000 degrees Farenheit. An armature may rise to 500 degrees. At this temperature, easily carbonizable materials, such as linen, cotton and other forms of cellulose are weakened, blackened and the resistance reduced. Shellac, although blackened at this temperature, is converted into those compounds whose resistance is not lowered. Shellac forms an exception, therefore, in being charred by such a temperature without reduction of resistance.

There is a greater detriment than chemical change by heat. The material cracks, becomes somewhat comminuted, and the resistances, both mechanical and electrical, are therefore greatly reduced. If paper or cloth, or even shellac is depended upon as the insulating material rather than as the binding material, it is not electric proof, because principally, it becomes, when charred, fractured at numerous points, if not completely pulverized. As to why shellac is not appreciably lowered in resistance by partial carbonization may be because it is an animal substance.

One of the most important attributes of an armature should be its rigidity. It should be like a rock in this particular. If the insulation should consist of a soluble material, for example, and the same dissolved out after the completion of the armature, or of some material that would be reduced in size by heat, then the wire and bolts would soon become loose from the rapid rotation and vibration, and finally the armature would be useless. Change in volume of the insulators has caused nine-tenths of the armature break-downs.

In the matter of insulation between the disks it was found that oxidized or rusted laminated armature disks would insulate without any addition of paper or similar insulating films. The only difficulty with such a construction is one of degree. Iron rust insulates, and it is heat-proof; but it does not insulate sufficiently to compensate in most instances for its simplicity and cheapness, and besides it is not applicable to any other part of the armature than between the laminæ of the core. The great advantage lies in the extreme thinness of the oxide coating, whereby a large amount of iron is obtained in the core. A modification has been suggested, which consists in placing thin mica sheets between every half-dozen of the disks. Again, iron wire, or ribbon rusted has been employed for armature cores. The wire or ribbon is formed into a ring, around which is the electric conductor. Another modification consists in "case-hardening" the iron, and also in japanning the surface. As to commutator insulation, natural mica sheets have been almost universally employed.

If it were not for the matter of mechanical construction and heat, shellaced glass would make a good armature insulator. It could be molded into any form and made of any degree of thinness. Its objections, however, are well known. Very gradually, and more so than would be conjectured, mica made its appearance in armatures. The introduction of mica into practice appears to have been brought about in the following manner:—An accident would happen to an armature, and before the next night it must needs be repaired. In order to make the temporary remedy, mica sheets or bars would be interposed. In the case of subsequent accidents, the portion repaired by mica, was the last to yield. Therefore it was proposed to build the armature primarily with mica. But this change took place very, very gradually, but surely. Manufacturers of stoves, the leading houses being also importers of mica, soon experienced a growth in the mica department of their business, until at present some import more for the electrical industry, especially for armature use, than for stoves. Why it was not employed from the first, no one could positively assert, otherwise than to guess that no one probably thought of it, or insulation was not considered of much comparative importance, or cheapness of material in construction was allowed to counterbalance efficiency of action and durability.

Of all substances, mica probably is the best material for use in armatures, if it is desired to obtain not only efficient electric insulation, but also durability under the influence of heat. The highest temperature to which an armature is subjected, even by short circuit or bad construction, will have no injurious effect upon mica. Mica, thick or thin, may be held in a gas flame without cracking, burning or melting. It remains unaffected. The reason of this is better understood when it is remembered that it consists of aluminic silicate, containing also potassic, sodic and lithic silicates, and some ferrous and ferric and manganic oxides. Its chemical constitution varies.

One quality of mica is that which is commercially termed amber mica, and is usually mined in Canada. It is so named from its appearance and not because it is amber or in any other way similiar to it than in its color. India mica is a commercial form noted for its uniform cleavage, great thinness of its laminæ, flexibility without fracture, and its resistance, which is much higher than that of amber. Carolina mica is another variety. It is obtained in sheets in the western part of North Carolina. It is the best mica for stoves, but it is too hard for some electrical purposes. Mica occurs in so many specific forms that particular names have been given to it. Muscovite is one of the most common varieties. It occurs in different colors, namely, a dark green, yellow, brown, white and gray.

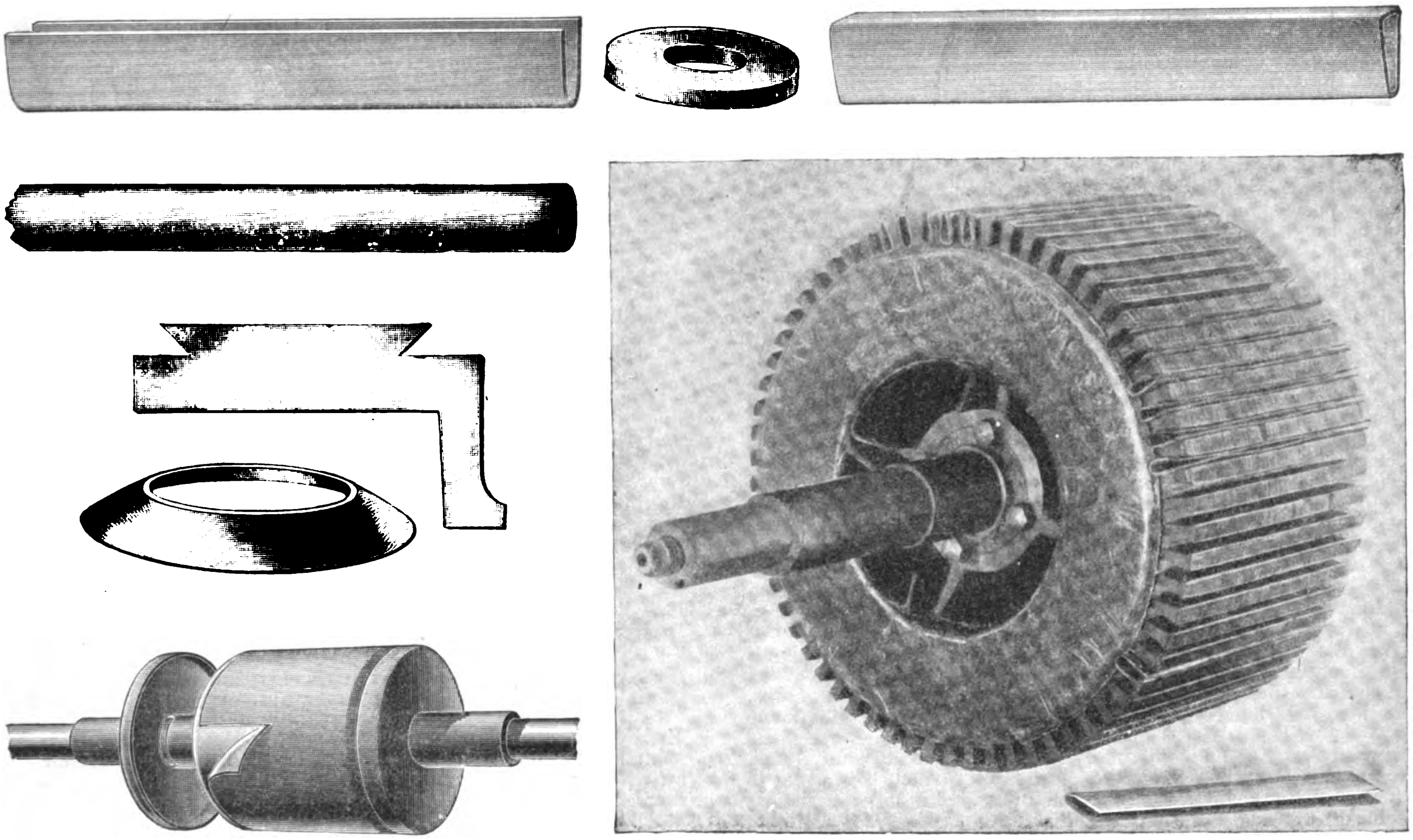
The insulating power of mica is superior to that of any other substance applicable to armatures. An advantage, peculiar to itself, is its even, laminated structure. How wonderful is the thinness of its individual layers! A piece of ordinary writing paper is about .005 inch. Mica layers have been obtained of a thinness of .00003 inch. Mechanical difficulties prevent its being split thinner. By pasting it upon a hard surface and splitting it off as much as possible, the remaining fragments are so thin as to become beautifully irridescent. The builder of armatures can therefore split the sheets into any desired and uniform thickness with great ease and accuracy. An interesting property of mica and one not generally recognized, is its homogeneity of structure and clear transparency, although so black when thick. The writer used a piece one-quarter of an inch thick for observing the recent solar eclipse. The effect was better than with smoked glass and as efficient as black glass much thicker.

A valuable property of mica in connection with commutator insulation is its proper degree of hardness, whereby it does not wear away too rapidly under the action of the brushes. If rubber were used, for example, even if it did not burn, yet it would wear off and sparking result, because the commutator surface would not be truly cylindrical. The brushes would be set into vibration. Again, mica is capable of the finest pulverization, so that any wearing which does take place does not result in the liberation of gritty particles, which would also cause sparking. Such mishaps occur with hardened artificial plastic insulators. The insulation should be just so thick that the current cannot jump across from one section to the other.

Although so superior for armature insulation, mica is, in its natural structure, accompanied by certain objections, which, in trying to overcome, were more serious than had been anticipated, as it was not until after a long series of trials that a successful article was produced, and not until a novel apparatus for cheapening the process of manufacture was devised. The apparatus is now in operation on a large scale. The description at present is confined, however, to the article, and to full information of its structure, manner of using and properties.

The objections alluded to are: Mica, as found in nature, occurs in flat sheets only. It has a high degree of elasticity, so that when once bent and released it assumes its original form. If folded, its brittleness causes fracture. If the natural sheets are compressed in a mold, to try to form armature insulator heads, for instance, it is completely broken up.

Secondly. Natural mica sheets correspond financially to plate glass. The larger the sheet, the higher the cost per square inch. Mica in small pieces, from four to six square inches, is exceedingly abundant and very cheap. It is often called waste mica, because very limited in its uses, and consisting often of trimmings from larger and more useful sheets. In medium and large sizes of armature, the naturally built up mica is so expensive as to be objectionable, although not so much so as to entirely prevent its employment.



Specimens of Micanite Armature Insulation.

Thirdly. Between the hundreds, nay, thousands, of thin layers damp air can enter, and also water, accidentally, which cannot easily or effectually be removed.

Fourthly. Mica splits so easily that handling causes injury.

Fifthly. Mica cannot be cut transversely to advantage. The edges are unworkmanlike, being ragged and jagged. Neatness in drilling, sawing and turning is difficult.

Among the attempts which have been made to overcome these objections are those involving the use of pulverized or comminuted mica, which is mixed with a liquid cement and stirred into a paste. While still soft, the mixture is rolled or compressed into any desired form, as if consisting of so much plaster-of-paris. In order to give it sufficient strength, one-third of the product is cement. The mica sparkles here and there on the surface, as it glitters on granite. This article should be called a cement insulator, and not a mica insulator, because the current can flow in a straight circuit through the plate without encountering any mica. The cement forms numerous rectilinear paths for the current independently of the mica, and therefore the product in no sense is an equivalent of mica.

A modification of this type of insulator consists of a coarse and thick textile fabric, whose pores and meshes are filled with a mixture composed of comminuted mica and a suitable adhesive substance. Another consists of finely divided asbestos mixed with pulverized mica, silicate of soda and sulphur compounds. It is molded by pressure into any desired form.

The comminuted mica-cement type is useful in trolley wire supports and similar insulators, but for dynamos it is useless, not only for the reason stated, but because of its softening and running under slight heat, being so necessarily rich in cement. If the cement is that kind that chars, the mica crumbles apart. Mineral powders have been mixed with it to render it more fireproof.

An example of the manner of using non-comminuted mica between the core and the windings consists in covering the core with paper, laying sheets of mica over the paper, then laying on another sheet of paper, fastening the whole together by convolutions of cords or similar ligatures, and finally applying the coils. During operation the paper and mica may shift from their positions, and thereby affect the rigidity of the armature as a whole. Again, the process of applying the pieces, and keeping them temporarily in position, requires repeated efforts and results in a display of crude workmanship.

The exhibits before you show practical results of work carried on for the purpose of overcoming the objections named.

Large Plates.—One of these plates is a yard square and .035 inch thick. Another is of the same size and 1 inch thick, and another about 4 inches by 12 inches and 1 inch thick. They have nothing to do directly with the armature; but could serve as foundation plates for a dynamo or motor. They are practically all mica. A *natural* plate of mica of the larger size would be a curiosity—a rarity. Any of the sheets may be cut up into any desired size and shape. The layers cling together much more tenaciously than in the natural plate. The path of least resistance from one side of the plate to the other is in a straight line, and a straight line intersects numerous mica sheets, and, therefore, the article is a mica insulator and not a cement insulator. These plates are made by such steps and apparatus that when subjected to heat in the armature, no injury whatever is produced.

Further, they are superior to a sheet of mica as it comes from the quarry, in that they do not absorb water or damp air; in that they are stronger to resist either pressure or tension; in that they may be neatly and easily sawed and drilled; in that they are enormously less costly; and in that they are of about the same resistance. By picking the exhibit apart, you can easily learn the structure. The mica of which it is composed is non-comminuted, but the pieces are exceedingly thin. The thickness is, by measurement, about .001 inch, *i. e.*, about as thin as tissue paper. The sizes vary from 2 to 6 or 8 square inches. In each layer of mica, you may notice that the sheets overlap at their edges, and the cement between the layers is hardly noticeable. The former mentioned plate weighs about four lbs., and the latter over 100 lbs. It is a convenient quality in connection with mica that it can be split into pieces of the thickness required for the particular device under the process of construction. This property is also possessed by the plates exhibited. A thin and long knife may be caused to force its way in any of the many planes parallel to the surface, for the purpose of reducing the thickness or obtaining several thinner sheets from one thick plate.

Some tests were carried on to determine the relative values of these plates, and plates of comminuted mica and cement. Using the words of the electrician who originated and performed the tests, he says: "For the purpose of insulating armatures, any solid insulating material should possess considerable strength and should maintain its strength when submitted to a moderate degree of heat. One piece tested consists of ground mica and shellac, mixed together and rolled or pressed between plates to a uniform thickness. In order to test it, I placed it upon a steam-table and left it for a minute, at the end of which period I tested its strength by pressing the end of a piece of wire against its surface with very light pressure. The end of the wire, which was blunt and made of copper, easily pushed its way through the sheet and left a hole when removed. In removing the sheet from the steam-table it warped. The second plate consists of layers of sheets of mica, cemented together with overlapping joints. This sheet I placed on the same steam-table used for the other sheet, and after one minute had elapsed, tried to thrust the same piece of copper wire through the plate, but without success, though exerting all the strength that could be brought to bear upon it by my hand. After the sheet had been on the steam-table for five minutes, I placed it on a thick iron plate, laid a piece of the same copper wire upon its upper surface, put a second sheet of wrought-iron on top of it, and put the whole into a hydraulic press. It was then submitted to a pressure of 2,000 lbs. per square inch for one minute, and the result was the flattening of the wire and a very slight crumpling of the mica sheet on the opposite side. The plate was then placed between two copper plates, and a weight of about four lbs. placed on the upper plate. The insulation resistance of the plate was then tested and found to be 25,500 megohms. I have used similar plates, similiarly prepared, in motors, upon which a load of 50 h. p has been placed, the entire thrust of the motor being received by the plates, which in this case were less than one-sixteenth of an inch thick. The temperature was brought up to 650 degrees Fahrenheit, sufficient to burn cotton and melt hard solder, without injuring the insulation."

Curved Specimens.—Similar remarks substantially, may be made about these, as about the large plates. Natural mica plates could never be given a permanent set, or molded into curved forms. The armature head consists essentially of an annular disc, provided with flanges around one or both peripheries. It is in one sense a continuous piece. The flanges, you may notice, are made separably and then fastened to the discs. There are no joints. Some of the peculiarly curved forms are furnished in order to illustrate that the article may be manufactured in any imaginable form of uniform structure, and in single pieces of uniform properties throughout.

Tubes.—In order to show the unlimited forms into which the material may be molded, a tube several feet long is exhibited. It may be cut up for use in certain types of armature, or when long, for use on board ship, and in general interior conduit installations.

Stamped Forms.—The flat pieces of peculiar form could be made from the beginning in individual pieces, but it is much cheaper, if stamped from larger plates. Before using the large plates for any purpose where an exact thickness is required, they are burnished or surfaced off by machinery. Some of the plates before you are in the crude state, and little scales here and there can be peeled off. The others are so different as to resemble a metallic surface, and when struck ring like metal. Some of the forms are for large commutators. Others are flat rings for field-magnet cores. The very irregular flat pieces are for certain types of commutators. On account of the almost metallic qualities the product can appropriately be termed an "insulating metal." For convenience, it is called micanite.

Commutators.—In equipping a commutator with this material, it is necessary to know something which has been learned by early users, only through experience. The insulating and metal sections are put together in the usual manner, and the whole is heated to a temperature higher than that which it will reach in actual practice. While still hot, the elements are clamped tightly together.

Among the exhibits, is a mass of odd pieces of mica sometimes called waste mica; also you will find similar pieces split as fine as possible. These are the results of the first operation. The next step consists in putting them together in the manner shown in the exhibits, that is, in layers with overlapping edges. Between them are layers of a cement having those qualities which fit the product for the purpose intended. Until only recently, these pieces were always laid on by hand. Their manufacture required one factory girl per cubic foot per hour. Now, one girl can do the work which formerly required twenty. The girl feeds the machine, and it does the rest. The amount of cement employed is practically infinitesmal, because while in a plastic condition, the mass is subjected to such a pressure that a mere trace remains, and yet sufficient to obtain proper adhesive qualities. From the beginning to the present, improved processes and new machinery have been required.

I will close this paper by presenting certain topics which appear to be suitable for discussion, but which need not be adhered to.

SUGGESTIVE TOPICS.

Armature.—Rigidity and its dependence upon insulating material employed. What has been learned by observation and special tests?

Preservation of Insulation.—Is it better to try to remove the cause of heating, or to neutralize the heat?

Burning Out Armatures.—What does insulation have to do with it, and what are the remedies? Also, what are the causes?

Durability of Insulation.—Differences in connection with armatures for inside use, such as installations and outside, *i. e.*, railway, mining and elevator use. Effects of atmosphere, motion and rough treatment.

Financial.—Does the expense of insulation, if the best, have an appreciable effect upon the cost of construction, and, on the other hand, will it pay in the end to put in a cheaper material?

Comparative Merits of Insulating Materials for Different Conditions.—Effects of high potential. Power to resist spark puncturing. What have tests shown as to properties of materials to withstand "break-downs," independently of high ohmic resistance?

Dr. James Bowstead Williams has carried on a long series of tests upon the comparative specific resistance of mica and micanite. The data and results are as follows:

The conditions of the tests were absolutely the same in all cases. The potential was constant, being over 3,000 volts. A dynamometer served to accomplish the same pressure for different materials. All the samples were kept at the same temperature and under the same hygroscopic conditions for several days. Samples were of uniform thickness. The best samples of micanite gave approximately the same reading as the best India mica, indicating that the resistance of micanite is equal to that of the best commercial mica.

RULES RELATING TO ELECTRIC LIGHTING AND POWER SERVICE AT THE WORLD'S FAIR.—II.

RULES GOVERNING LIGHT AND POWER IN ELECTRICITY BUILDING TO BE SUPPLIED BY THE WORLD'S COLUMBIAN EXPOSITION.

Exhibitors in the Electricity Building will be divided into two classes: First, those who contribute to the service of lighting and electric power transmission for the building; second, those who do not so contribute.

Contributors will be again divided into two classes:

(1) Those who furnish generators connected to prime movers in machinery hall.

(2) Those who contribute to the service lighting of electricity building through motor power taken from circuits in the electricity building.

Contributors to either class will be required to enter into a formal contract with the director-general, to be approved by the director of works, for furnishing and operating machinery offered in accordance with the following general terms:

No steam power being available in the electricity building, all generators provided by contributors of class (1) must be installed in machinery hall. Generators provided by American companies will be located in the regular service plant in machinery hall. Generators provided by foreign companies will be located in the spaces severally allotted to these countries in machinery hall.

Power circuits will be led from the generators of each contributor of class (1) through existing subways from machinery hall to the electricity building. The several exhibitors offering generators for this service are expected to furnish and visit all at their own expense the several power circuits before mentioned, subject to the supervision of the chief of department of electricity.

The aisles of the electricity building will be illuminated by arc lights, which will be considered the service lighting for the building. Arc lights, in addition to these, as well as all incandescent lights, and power for keeping exhibits in motion, will be considered as special service rendered to individual exhibitors.

Power for operating generators needed for the service lighting will be furnished free of cost to the exhibitors installing this light. In consideration of such contribution to the service lighting of electricity building, exhibitors participating in this service will be granted such amount of extra power and light for the operation of their own exhibits as may be mutually agreed upon between them and the director-general.

Arc and incandescent lights may be taken direct from the several power circuits leading from machinery hall, or they may be furnished from generators driven by motors taking current from the power circuits before mentioned, motors and generators in this latter case being located in the electricity building. Arc lights for all night service are an exception to this rule, and will be supplied from the regular service plant already contracted for by the World's Columbian Exposition.

Contributors of class (2) who use current from the power circuits will be expected to provide the necessary motors, generators, and shaft free of cost to the World's Columbian Exposition. Exhibitors contributing to the arc lighting necessary in the service of the building will be expected to wire, hang and maintain such lamps as may be assigned to them free of cost to the World's Columbian Exposition. Such arc lamps, incandescent lights and motors as may be installed within the contributing exhibitors's space will be wired and hung by said exhibitor at his own expense.

In order to provide for lighting and power service to those exhibitors who do not contribute to the service of electricity building, it is proposed to assign to each exhibitor contributing to said service a specified portion of the electricity building in which to furnish special lighting and power. All works of wiring, hanging and maintenance of lamps, etc., done for other exhibitors in such space will be paid by the World's Columbian Exposition at the following rates:

(1) For each incandescent lamp, including the first lamp and socket with installation on a plain cord or pendant, $3.50 per 16 candle power lamp.

(a) Special fancy wiring will be furnished at an extra cost to be paid by consumer under special agreement with the director-general, approved by the director of works.

(b) Fixtures and shades will be furnished and maintained by consumer.

(c) Lamps of other capacities, fancy or colored lamps, will be furnished in accordance with special agreement with the director-general, approved by the director of works. Lamp renewals must be furnished free of charge by contributor. Breakages must be purchased by the consumer from the exhibitor supplying his exhibit, at the usual market price.

(2) For each arc lamp, including ceiling block, suspension rod and lamp complete, $35. Lamps must be furnished with opal globes. All care and attendance to lamps and circuits must be furnished without extra charge by the contributor maintaining the circuit.

(3) All wiring necessary for the installation of motors within the space assigned to each contributor shall be done by said contributor at the expense of exhibitor desiring said power, at the following rates:

One-half horse power and less, $8.00.

One to five horse power, per horse power, $5.00.

More than five horse power and not exceeding ten horse power, per horse power, $10.00.

More than ten horse power, per horse power, $8.00.

Fractions of a horse power will not be considered except for motors of less than one horse power. In all cases the rating of the motor will be the standard rating of the manufacturer.

Service connections, as well as all lamps and sockets, installed at contributor's expense, shall be maintained and owned by said contributor. All alterations of original installation shall be made by said contributor after written agreement between the exhibitor desiring change and the director-general, approved by the director of works.

All installation and operation shall be subject to the inspection and approval of the chief of the department of electricity. Installation must conform to the national code of the Board of Underwriters, subject to the inspection and approval of the director-general.

Service will be provided only from May 1 to November 1, 1893, and during exposition hours, except by special authority from the director-general and director of works.

The service rendered will be entirely at the risk of the consumer. The World's Columbian Exposition will not be responsible for stoppages from any reasonable cause.

RULES GOVERNING THE SUPPLY OF LIGHTING AND POWER TO EXHIBITORS IN THE DEPARTMENT OF ELECTRICITY.

Electric power only will be supplied in the electrical building. The aisles of the building will be illuminated with arc lamps without cost to exhibitors; additional lighting to be paid for by exhibitors at the following rates:

Arc lamps, service May 1st to October 31st, 1893, during exposition hours, $65.00 per lamp of 2,000 nominal candle power. Lamps suspended from ceiling with opal globes and globe nets; special fixtures or globes, or special ornamental lamps, will be subject to an extra charge to be fixed by the director-general and the director of works.

Incandescent lamps, service May 1st to October 31st, inclusive, 1893, during the hours of the exposition, $8.00 per 16 candle power lamp, including installation of first lamp and socket and lamp renewals. Breakages must be purchased by exhibitor of the contractor lighting his space, at the usual commercial rate. Lamps will be hung on plain cord or pendant. Special or fancy wiring will be furnished at an extra charge to be fixed by the director-general and the director of works. Fixtures and shades will be furnished and maintained by consumer. Special colored or fancy lamps, or lamps other than 16 candle power, will be subject to special agreement with the director-general and approved by the director of works. Installations of 300 lamps or more will be subject to special discount to be fixed by the director-general.

MOTORS.—Exhibitors requiring motive power will furnish necessary motors, rheostats, main line switches, insulating base, etc., complete, together with all belts, counter-shafting, and other means of connecting motors to operating machinery. Motors should be suitable for operation on the class of circuit furnished in exhibitor's location.

The rheostats must be constructed wholly of non-combustible material. The main line switch shall be of the knife blade type, of ample carrying capacity, and suitable for breaking current at the potential used. Motors shall be erected in position at the expense of the exhibitor by the contractor furnishing power in the location of his exhibit, service connections to motors being installed, maintained and owned by the said contractor.

Charges for service connections with the main line will be as follows:

For one-half horse power and less, $8.

For one horse power to five horse power, per horse power, $12.

For more than five horse power and not exceeding ten horse power, per horse power, $10.

For more than ten horse power, per horse power, $8.

Fractions of a horse power will not be considered, except for motors of less than one horse power.

Ratings of motors will be the standard rating of the manufacturer.

Charges for service will be based on the maximum electrical horse power delivered to the motor, irrespective of the class of work to be operated by the motor, at the following rates:

For ¼ horse power and less, $15.

For more than ¼ horse power, and not exceeding ½ horse power, $30.

For more than ½ horse power, and not exceeding one horse power, $50.

For more than one horse power, and not exceeding two horse power, per horse power, $45.

For more than two horse power, and not exceeding three horse power, per horse power, $42.50.

For more than three horse power, per horse power, $40.

A limited amount of power may be furnished to exhibitors free of charge to simply turn over an otherwise inoperative exhibit.

LETTERS TO THE EDITOR.

EFFICIENCY OF ALTERNATING PLANTS.

IN the letter under this head in THE ELECTRICAL ENGINEER of Dec. 14, W. H. C. is evidently aiming in the right direction when he asks, "Can so large a loss be due to the inefficiency of the transformers?"

Taking his own figures, given in the letter, he has 1,299 lights wired up on 97 transformers. Assuming that he has a transformer capacity of 1,300 lights, this would average 13 lights per transformer. If we take the figures given by Mr. L. B Stillwell in his paper read before the National Electric Light Association at Buffalo, Feb. 23, 1892 (an abstract of which is printed in THE ELECTRICAL ENGINEER, of March 2, 1892, page 214), and assuming that the transformers are of 10-light capacity each, the iron loss would be five per cent. at full load as given by Mr. Stillwell in his paper; and this would give a reading on the station ammeter of 3.25 amperes according to the following calculation: 1,300 light transformer capacity. Assuming 1 ampere per light, and the ratio of transformation to be 20 to 1 would give 65 amperes required to run transformers fully loaded. 5 per cent. for iron loss, that is, 5 per cent. of sixty-five = 3.25 amperes on station ammeter. This loss is constant whether lights are burning or not.

W. H. C. also gives the actual revenue as $725.60, with the consumer's rate at 1 cent per ampere hour; this gives 72,560 ampere hours by meter for the month. He also says that they run eight hours per day and thirty-one days to the month; this gives 293 as the average amperes per hour for the month from house meter readings.

Assuming, as before, 1,300 light transformer capacity, this gives less than 25 per cent. as the average load upon the transformers; this would run up the relative iron loss to about, or over, 20 per cent. and reduce the efficiency of transformers to 80 per cent., or less, on the average. This accounts for about one-half of the difference between the station readings, as given, and the house meters.

It may be that some of the house meters do not work properly or are interfered with by the consumers of light, or that they tap the wires before reaching the meters, or that the transformers are less efficient than here assumed.

The coal burnt per hour is 5.49 pounds per electrical horse power at the station for the month, which certainly should be reduced.

W. H. C. makes a fair showing, however, when he takes his reading from log book for Sunday and Tuesday, as follows :

	Sun.	Tues	Difference in amperes.	
Total ampere hours.	154	214	61	Hours and coal burnt on Sun. and Tues. on a run of 8 hours.
Coal consumed.	1,500	1,750	250	

61 (ampere hours) × 1,100 (volts) ÷ 746 (watts) = 90 E. H. P. hours nearly. $\frac{250}{90}$ = 2.8 pounds of coal per E. H. P. hour which I should say was very good, judging from what his plant is like from the reading of his letter. I should also be inclined to think he had excessive friction in engine or leaks in the steam system.

I should favor adding to W. H. C.'s log-book records, the following : (1). The number of pounds of water used during each run taken from meter in feed pipe to boiler. (2). Boiler guage readings at the end of each hour. (3). Wattmeter readings for each run from meter in the mains. These would enable him to check the run month by month and to note any change in the coal burnt and in the running expense of the station and help to locate each fault and correct it.

PITTSBURGH, PA. C. M. GREEN.

WITH reference to "W. H. C.'s" letter in THE ELECTRICAL ENGINEER of December 4, I do not think that the causes of the apparent discrepancy to which he alludes are far to seek.

The estimate that twenty lamps would call for only one ampere at the station is, of course, quite wrong. From the figures given it is evident that each lamp requires $\frac{6022}{72560}$=0.083 ampere at the station, or about twelve lamps to the ampere; 0.083 ampere at 1,100 volts is 91.3 watts.

Now, an ordinary 16 c. p. lamp takes nearer seventy watts than sixty. This gives an efficiency of, say, 73 per cent. roughly. Of the remaining 17 per cent. the line losses would account for, say, 4 per cent., leaving 13 per cent to locate.

Now, "W. H. C.'s" transformers are very small, averaging only 13.4 lamps each, and they are necessarily underloaded during part of the run. Might not they alone account for the whole of this 13 per cent?

But there is yet another factor to be considered. If you are thinking about power you must not trust too implicitly to an ammeter when using an alternating current, be the volts ever so constant; for unless the current be in step with the E. M. F. the ammeter, though it will correctly indicate the current, will, nevertheless, lead you to overestimate the power in a way which is well known, but is too complex to explain here. Now, as the plant is not shut down till midnight, the transformers are underloaded during a considerable part of the run, as, indeed, the table given shows, and in this case the current cannot be exactly in step with the E. M. F.

Taking these considerations into account, I do not think that "W. H. C." will be able to materially reduce the apparent discrepancy. Indeed, he is to be congratulated that he does not have to keep the potential on the mains twenty-four hours a day. If he did, the apparent discrepancy would be far greater.

December 17, 1892. N. W.

I HAVE read the article of "W. H. C." under the above title, but from the data given it would be impossible to locate the trouble. It is not inefficient *generation* of current that "W. H. C." complains of, as he draws his conclusions from the difference between his station amperemeter readings and the readings of the house-meters. This would leave out of consideration the efficiency of the dynamos, and would show that the "leakage" took place between the plant and the lamps of the consumer. As the total lamp capacity of the 97 converters is not given, it cannot be stated whether or not the converters are underloaded.

It would seem to me likely that the discrepancy may be due to a little of everything; a little line drop, a little of too many converters for the load, a little inefficiency in the converters, and a little sluggishness of the meters. It is wonderful how a number of little things, when piled on top of each other, will mount up.

A. W. MESTON.

ST. LOUIS, MO.

THE DESIGN OF THE LUNDELL MOTOR.

THE writer would like to say a word or two about the type of motor described in THE ELECTRICAL ENGINEER of Dec. 7, under the name of the Lundell Motor.

In the Fall of 1888 the writer designed and built for the Cleveland Motor Company, of New York, a 1 h. p. motor of the type since adopted by the Interior Conduit and Insulation Company, and called the Lundell motor. A glance at the cuts representing the so-called Lundell motor will show the reason why such a type of motor will be less efficient and more costly than other motors of good types, and consequently why the writer abandoned the type.

It is just as important that the wire of the field coil should include the necessary cross section of iron with the minimum length of wire, as in the armature. In the type of motor under discussion the cross section included by the field coil is many times larger than the necessary cross section of iron for the magnetic circuit. The consequence is that the length of wire per turn is much increased, thereby increasing the watts consumed in the field coil, and at the same time greatly increasing the cost of field, in labor and material. The writer proved this by using the same armature in motors of two types now widely used, the conditions otherwise being the same, and found that the motor having the field coil surrounding the armature concentrically, as in the so-called Lundell Motor, consumed more than double as many watts for exciting the field, and that the cost of wire and labor was in proportion. The cost of winding and wire is an item of considerable importance in machines for constant potential, needing fine wire for the shunt, and especially for high potential motors.

OLAF DAHL.

NEW YORK CITY.

LEGAL NOTES.

EDISON VS. SAWYER-MAN.

EDISON ELECTRIC LIGHT COMPANY AND EDISON GENERAL COMPANY *vs.* SAWYER-MAN ELECTRIC COMPANY.

IN pursuance of the decision of December 15, the United States Circuit Court of Appeals made the following order, December 19 :

This cause having come on to be heard on appeal from the order of the Circuit Court of the United States for the Southern District of New York, entered herein November 19, 1892, granting a preliminary injunction against the defendant, and counsel for the respective parties having been heard by the court upon the said appeal, it is

Ordered that the said injunction order appealed from be modified so as to cover only lamps made in infringement of the second claim of the patent in suit, and also by inserting a provision reserving the right to the defendant to move hereafter for the vacation, suspension or modification of the injunction upon proof of specific instances of refusal on the part of the complainants, or either of them, to supply the lamps of the patent, upon terms reasonable under the circumstances of the particular case, to the owners of electric lighting apparatus which was installed or purchased before the rendition of the interlocutory decree of the Circuit Court sustaining the validity of the patent for use with such apparatus, and that the order, as so modified, be affirmed.

And it is further ordered that a mandate issue to the said Circuit Court directing the said court to modify the said injunction order as above stated, and to proceed herein according to law and justice and to the opinion of this court.

LITERATURE.

Wissenschaftliche und Technische Arbeiten von Werner Siemens. Vol. II. Technical Works. 2nd Edition, Berlin, 1892. Julius Springer. X +, 601 pp. 6x9 inches. Price, $3.80.

THE recent death of Werner von Siemens makes this a fitting time for a review of the work of one who had devoted his lifetime to the furtherance of science, and of the electrical arts in particular. There is probably no field of electrotechnics in which Siemens has not done some work, and few in which he has not distinguished himself. A record of such work must therefore not only be valuable from an educational standpoint, but highly entertaining at the same time. The present work is a complete record of electrical and other technical work of Siemens, beginning with the description of his first patent for the obtaining of a gold plating solution, in 1842. It takes us through all the telegraph work of this great inventor, gives the original description of the Siemens polarized relay, and carries us through various stages of the Siemens armature up to the discovery of the principle of the dynamo electric machine. The work is compiled from the original sources and is brought up to within the last year, and so may be said to contain practically all of Siemens's work. It is a most remarkable record, and if, as has been truly said, "A man's works are his monument," Werner Siemens needs no bronze tablet to perpetuate his memory.

The book is well illustrated from original drawings and is in every way got up in a manner worthy of the subject.

RELATIONS OF THE GENERAL ELECTRIC AND WESTINGHOUSE COMPANIES.

RESPECTING a rumor that the contract for lighting the World's Fair has been turned over to the General Electric Company by the Westinghouse Company, we are authorized to say that it is wholly unfounded and that the Westinghouse Company has had no negotiations, either directly or indirectly, with the General Electric Company, or with any of its representatives looking towards the turning over of this contract, or towards a union of interests. The Westinghouse people claim that with their new lamp, at the low prices quoted, without infringing the Edison patents, with their business now earning at the rate of 15 per cent. per annum, with orders on hand to keep their factory running night and day, with representatives of local companies of the General Electric Company coming to ask terms for the use of the new lamps—with these advantages they claim that there is every reason why their independent course should be maintained, in the interests of their stockholders. They say that the addition to the works of the company now being completed will raise the capacity of all of its shops to an output of $10,000,000 per annum

PERSONAL.

MR. FRANCIS R. UPTON, who has so long been the manager of the Edison Lamp Works, has now been made general manager of the incandescent lamp department of the General Electric Company. The position and honor have been won by long years of hard work in a peculiarly difficult field of electrical industry, and Mr. Upton will receive the personal congratulations of a host of friends.

HON. GARDINER C. SIMS has just returned to New England from a long Southern trip. He found on his arrival home that he had been appointed arbitrator for the city of Providence on its new contract with the Narragansett Electric Lighting Company.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED DECEMBER 13, 1892.

Accumulators:—

Manufacture of Secondary Battery Electrodes, W. W. Griscom, Haverford, Pa., 487,834. Filed Sept. 30, 1892.

Employs a grid consisting of a group of supporting frames filled with thin sheets separated from one another slightly and the spaces filled when the sheets are sufficiently converted into active material.

Alarms and Signals:—

Signaling Device for Railways, Z. Krulis, Chicago, Ill., 487,904. Filed Mar. 28, 1892.

An automatic track signal in which the circuit is closed by the car in passing over a pin projecting slightly above the rail.

Electric Signal Circuit, J. V. Young, Boston, 488,138. Filed June 29, 1892.

System of electric block signals for steam railways.

Contact Rail, F. E. Kinsman, Plainfield, N. J., 487,752. Filed Feb. 23, 1892.

Consists of a rail having a contact edge or corner in combination with a circuit closer adapted to make longitudinal rubbing and side contact with the edge of the rail.

Conductors, Conduits and Insulators:—

Insulator, C. Wirt, Chicago, 488,046. Filed Jan. 4. 1892.

Consists of two parts each provided with an eye and hook at one end and one with a cup and the other with a body adapted to be received within the cup; the opposed surfaces of both being corrugated and a mass of insulation filling the intervening space and entirely surrounding both the cup and the body.

Process of Insulating Electric Conductors, C. Cuttriss, New York, 488,141. Filed Jan. 20, 1892.

Has for its object to render available for purposes of insulating electric conductors raw cotton in the form known as sliver.

Dynamos and Motors:—

Armature for Electro-Magnetic Machines, R. Lundell, New York, 487,755. Filed Feb. 5, 1892.

Employs an armature core having a series of holes near each edge, a series of U-shaped conductors insulated from the core, the legs of which extend through the holes and means for causing each conductor to grasp the core.

System of Electrical Transmission of Power, N. Tesla, New York, 487,796. Filed May 15, 1888.

Claim 3 follows:

The combination with a multipolar alternating current machine having independent induced or current generating circuits, of motors having independent energizing circuits and a smaller number of poles than the generator.

Automatic Safety Device for Dynamo Electric Machines, F. B. Badt, Chicago, Ill., 487,816. Filed Feb. 19, 1892.

Employs a responsive device in the main circuit, connections whereby a local circuit is closed when the main current has reached a pre determined maximum, and a circuit changer to throw resistance into the circuit and controlled by the responsive device.

Armature for Electric Machines, B. G. Lamme, Pittsburgh, Pa., 488,016. Filed Feb. 8, 1892.

Claim 1 follows:

The combination with a drum armature core having radiating teeth of separately wound coils placed within the spaces between the teeth each, coil spanning several teeth.

Electric Motor, I. E. Storey, Boulder, Colo, 488.041. Filed Feb. 4, 1892.

Employs a field magnet consisting of a cylinder surrounding coils of wire in combination with pole pieces extending from opposite points at the edges of the cylinder and other pole pieces extending inward from about midway between the edges of the cylinder and embracing the coil.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, H. T. Johnson, New York, 487,839. Filed April 1, 1892.

A battery in which the positive electrode forms the case and the negative electrode is placed within, depolarizing and exciting agents being placed between the two electrodes together with a lining of absorbent material.

Lamps and Appurtenances:—

Casing for Bases of Incandescent Lamps, G. R. Lean, Boston, & C. B. Burleigh, Chelsea, Mass., 487.816. Filed Nov. 27, 1891.

A casing made in two parts, one ring shaped and the other cup shaped, the latter extending above the lower end of the base and compressing a packing between itself and the former.

Manufacture of Incandescent Electric Lamps, C. Pauthonier, Boston, 487,890. Filed April 20, 1892.

Method consists in first sealing the leading-in wires into the bulb, then introducing the filament into an opening into the bulb and affixing it in conductive relation to the electrodes after which the vacuum is formed and the bulb is sealed.

Incandescent Lamp, E. W. Applegate, Omaha, Neb., 488,139. Filed April 7, 1892.

A separable incandescent lamp made with the object of having its filaments readily replaced in case of breakage.

Measurement:—

Electric Meter, C. W. Ayton, New York, 487,703. Filed Dec. 5, 1891.

Employs an ammeter or similar instrument the needle of which is attracted at periods of time, in a direction at right angles to its normal direction of movement, and closes one or more circuits according to the amount of current actuating it.

Time Meter for Electric Lighting Systems, J. O. Ball, Mount Pleasant, Iowa, 488,107. Filed Feb 20, 1892.

Employs a movable registering device and a cut-off connected therewith and adapted to throw it into and out of engagement with a clock mechanism when the circuit is closed or open.

Miscellaneous:—

Speed Indicator, W. H. Abbott, Lennoxville, Canada, 487,702. Filed Aug. 12, 1891.

Employs a mechanism adapted to make and break a circuit at each revolution of the wheels, and a clock having a movement providing a switching device by which two sets of electromagnets are alternately brought in and out of the circuit, the speed in miles per hour being indicated on the dial.

Means for Transmitting Power, W. E. Walsh, San Francisco, Cal., 487,805. Filed May 2, 1892.

Magnetic Separator, H. S. Chase, Boston, 488,064. Filed Jan. 29, 1892.

Railways and Appliances:—

Conduit for Electric Railways, J. W. Hayden, Ft. Wayne, Ind., 487,785. Filed Jan. 16, 1892.

Consists of a closed slotted box terminating in a drain at its lower end and having the trolley supports at one side and protected by an overhanging flange.

Trolley Catcher, J. Werling and J. P. Agnew, Minneapolis, Minn., 487,808. Filed Feb. 25, 1892.

Consists of a retractile device connected with the lower end of the trolley pole rope and means for tripping the device in the event of the trolley rising above the wire.

Electric Railway Trolley, A. Woerner, Buda-Pesth, Austria, Hungary. Filed Feb. 8, 1892, 487,818.

Consists of a frame and a long roller instead of the grooved trolley wheel in ordinary use.

Electric Railway Trolley, D. Mason, New York, 488,022. Filed Nov. 11, 1889.

Employs a contact device making underneath contact with the trolley wire, a pole carrying said contact device and a flexible resilient support for the pole.

Electrolytic Apparatus, T. Craney, Bay City, Mich., 487,996. Filed Jan. 4, 1892.

Lightning Arrester, W. R. Garton, Keokuk, Iowa, 483,002. Filed July 11, 1892

Consists of a solenoid having an armature provided at one end with a guide rod which receives a flexible conductor and at the opposite end of the carbon rod in combination with a pair of serrated plates with their faces near each other but out of contact, the one connected with the ground and the other with the carbon of the armature.

Electric Gas Lighter, L. M. Kilburn, Council Bluffs, Iowa, and S. Van Etten, Omaha, Neb., 488,012. Filed Mar. 21, 1892.

Electric Belt, O. Kjorstad, Eau Claire, Wis., 488.013. Filed May 11, 1892.

Automatic Regulator, E. J. Houghton and W. White, 483,121. Filed Mar. 26, 1892.

An apparatus which automatically introduces into the circuit more or less resistance according as the E. M F. of the current is greater or less.

Electric Coupling, J. J. Purcell, Washington, D. C., 488,027. Filed June 18, 1892.

An air-tight case containing an insulating material completely covering the junction of two underground cables.

Electric Railway Trolley, D. Mason, New York, 488,023. Filed March 3. 1890.

Employs a spiral spring coiled on a horizontal axis and connected with the car and exerting an upward pressure upon the pole.

Switches and Cut-Outs:—

Automatic Switch, N. Newman, Springfield, Mass., 487,881. Filed Aug. 2, 1892.

Relates to means for automatically closing or breaking a circuit at some premeditated time.

Spring Jack Switch, C E. Scribner and E. P. Warner, Chicago, 488,083. Filed July 3, 1888.

Provides means for readily looping or connecting metallic circuits.

Electrical Safety Cut-Out, H. S. Keating, London, Eng., 488,123. Filed Aug. 31, 1892

Consists of a U-tube hermetically closed at one end and containing mercury above which is a charge of nitrogen adapted to expand and break the circuit.

Telegraph:—

Automatic Keyboard Operator, H. S. Prentiss, Elizabeth, N. J., 487,936. Filed June 19, 1891.

Employs a series of contact closers, a series of switches operated by the passage of a perforated strip between the circuit closers, and a main circuit closer for closing the circuit through the contacts set by the switches.

Printing Telegraph, C. L. Buckingham, New York, 487,981. Filed Nov. 10, 1888.

Employs a type wheel having four rings of type in combination with apparatus for adjusting it in one direction or the other from an intermediate position on its axis.

Printing Telegraph, C. L. Buckingham, New York, 487,982. Filed Apr. 24, 1890.

Has for its object to produce a type telegraph by means of which messages may be printed as rapidly as they are produced by the Wheatstone system, while employing only about the same number of main line pulses.

Printing Telegraph, C. L. Buckingham, New York, 487,983. Filed Apr. 29, 1890.

Similar in its object to 487,982.

Synchronous Multiple Telegraph, C. L. Buckingham, New York, 487,984. Filed Apr. 30, 1890.

Employs a synchronizing arrangement consisting of a battery at the receiving station, a duplex relay at the transmitting station and a local circuit, by which a unison motor is controlled.

Printing Telegraph, C. L. Buckingham, New York, 487,985. Filed Dec. 14, 1889.

Enables spacing between words while the wheel remains in its initial position, and by the repeating of the characters in a message while the wheel remains in a fixed position and adjusted to print such characters.

Printing Telegraph, C. L. Buckingham, New York, 487,986. Filed Apr. 25, 1890.

Relates to the application of printing mechanism to the synchronous multiple telegraph.

Telephones and Apparatus :—

Multiple Switchboard Signal, G. Taintor, Keene, N. H., 487,795. Filed Apr. 7, 1892.

Employs an auxiliary resistance normally in circuit with the central station connecting apparatus, a normally discontinuous shunt circuit around said resistance, and a circuit closer mounted in a plug socket connected with the main line circuit of the annunciator.

Multiple Switchboard Circuit, A. H. McCulloch, Boston, 487,852. Filed Mar. 9, 1892.

Invention consists in combining a peculiarly constructed call annunciator and the main circuit within which it is included with two sources of electricity and means for connecting both with the circuit at the same time by the act of sending the out-going signals.

Multiple Switchboard Busy Test Circuit and Apparatus, J. L. McQuarrie, Boston, 487,853. Filed Apr. 7, 1892.

Has for its object to provide a system of test appliances which shall be efficient without unnecessary complication in circuits or apparatus.

Busy Test Apparatus for Multiple Switchboards, J. L. McQuarrie, Boston, 487.854. Filed Apr. 7, 1892.

Provides means for testing a line at any one section of a multiple switchboard to see if it is already in use at another section.

Means for Preventing Induction in Cables of Multiple Switchboards, 488,084. Filed Mar. 5, 1882. C. E. Scribner, Chicago. Ill.

Invention consists of a third wire connected at one extremity to that side of the line circuit which opens when connection is made to a line twisted with the wires constituting two sides of the line circuit into a triple strand extending through the cable connected to the spring jacks and to the annunciator and terminating in an open extremity.

Multiple Switchboard System for Telephone Exchanges, C. E. Scribner, Chicago, 488,035. Filed May 17, 1892.

Has for its object to automatically render the individual annunciator of the line inoperative when the connection is established with any spring jack of a line without including any contact points in the line circuit.

Multiple Switchboard System for Telephone Exchanges, C. E. Scribner, Chicago, Ill., 488,036. Filed Apr. 16, 1892.

Consists of a normally open shunt about the individual annunciator of the line and means actuated by an electromagnet to close the shunt circuit while a connection exists to the line.

Telephone Switchboard Apparatus, C. E. Scribner, Chicago, Ill., 488,037. Filed April 16, 1892.

Similar in its object to 488,036.

Multiple Switchboard System for Telephone Exchanges, C. E. Scribner, Chicago, Ill., 488,038. Filed April 18, 1892.

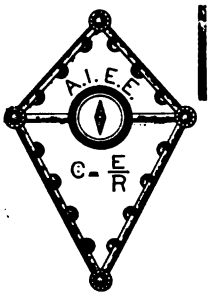
Similar in its object to 488,036.

Test Circuit for Multiple Switchboards, O. A. Bell, Brooklyn, N. Y., 488,058. Filed March 12, 1891.

Has for its object to provide means whereby a line which is in use may give the busy test, which means however shall not have any electrical connection with the telephone line itself.

SOCIETY AND CLUB NOTES.

PROPOSED BADGE OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.



Proposed Institute Badge. Twice Actual Size.

THE American Institute of Electrical Engineers has for years contemplated the adoption of some type of badge or pin similar to those of the various engineering societies, and the present committee which has the matter in hand has presented a large number of models and designs of more or less merit and originality. One of these which seems to meet with general approval and is certainly characteristic of the profession of electrical engineering, was presented for consideration to the Council and the Institute by its designer, Mr. W. J. Hammer, of the committee, with a view of securing a full criticism by the members. THE ELECTRICAL ENGINEER to give the matter still wider publicity herewith presents an explanation of the pin and on behalf of the committee requests any members who desire to submit new designs or suggestions for changes in this one, to forward them to the secretary, Mr. Ralph W. Pope, No. 12 West 31st street, New York City.

As will be seen, the pin represents Franklin's kite, which demonstrated the identity between lightning and electricity. It represents static electricity and is a recognition of America's first electrician and philosopher. The arms of the kite form a diagrammatic representation of Wheatstone's bridge. The binding posts at the corners are small pearls, but in the original design were gold balls which are perhaps preferable.

In the centre is a galvanometer, representing magnetism and induction; the needle is of blued steel placed under a piece of amber. The amber which is enclosed within a ring of gold, represents the first conception of electricity dating back to B. C. 600, when Thales the Greek philosopher recorded the fact that amber when rubbed attracted light particles to it, and the Greeks worshipped it, believing the gods had endowed it with life. In A. D. 1600, Dr. Gilbert, court physician under Queen Elizabeth, coined the word electricity from the word elektron, the Greek name for amber.

Above the galvanometer are shown the initials of the Institute, A. I. E. E., and below Ohm's law, $C = \frac{E}{R}$. Underneath this upon the original design was the date 1884, in which year the Institute was organized but this was objected to as giving the pin too much the character of a college class pin. Around the edge was engraved "What hath God wrought," the first message sent by the Morse telegraph. This was objected to as identifying the pin with a particular department of electrical work while otherwise the pin is general in its signification. It is proposed to make it a trifle larger and the gold wire forming the arms of the bridge will be somewhat smaller. Mr. Hammer has left the pin at the office of THE ELECTRICAL ENGINEER, where it may be seen by those who may care to inspect it.

THE DISSIPATION OF ENERGY IN HERTZ RESONATORS.

IN the article on the above subject by Prof. Bjerknes, appearing in our issue of Dec. 14, two errors are pointed out, due to misprints in the original source, the *Comptes Rendus*.

The period of oscillation should be 1.4×10^{-8} (not 14×10^{-8}). Four words are omitted from the last sentence, which should read: "That metals are more transparent to Hertzian undulations than to luminous undulations."

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

Prosperity and profit are promoted by persistent publicity.

CONSOLIDATION OF THE ELECTRIC LIGHTING INTERESTS IN CLEVELAND, OHIO.

IT has recently come to light that the General Electric Company has consummated a deal with the local electric lighting companies, whereby the franchises and business of the "Cleveland Electric Light Company" and the "Brush Electric Light and Power Company" are transferred to the new organization known as the "Cleveland General Electric Company." This latter company was incorporated with a capital stock of $25,000, which was soon afterwards increased to $1,000,000. Last winter a bill was introduced into the legislature giving the city the right to issue bonds for the purpose of installing a municipal plant, with the hope of obtaining better service, and of furnishing light to a larger territory. As this is also one of the objects of the new company, the explanation of the consolidation is no doubt an effort to defeat the above bill. The two local plants will continue operating as usual for the present, but in all probability the new station which is spoken of will be simply an addition to the one occupied at present by the Brush Company, not only because of its very central location and adjoining vacant territory, but also because of the abundant water supply and the ease in handling fuel.

At this station will be located all the arc and alternating machines, and the building now used by the Cleveland Electric Light Company will contain the direct current and power generators for stationary motor work. The new company will no doubt do much to better the lighting industry of the city. Prices should go down and service go up, and means will be forthcoming for the placing of the wires underground, where they were ordered to be put by ordinance more than a year ago, but with which ordinance the present companies are really in no position to comply, because of their small patronage.

Cleveland has a population of 300,000, yet the combined business of the present companies is only about 1,600 arcs and 12,000 incandescents, which indicates that there is a large field for development. If the city starts in aright with this new company, it will not only request, but enforce its request for, a compliance with the underground ordinance, at least in the business portion of the city, and once started by the lighting companies it will be a matter of but a short time before the feeders for the railroads are also out of sight. The local telephone company by February 1, 1893, will have 2,000 miles of its wires beneath the surface.

W.

THE DE RYCKE "STRAIGHT LINE" CENTRIFUGAL SEPARATOR AND GREASE EXTRACTOR.

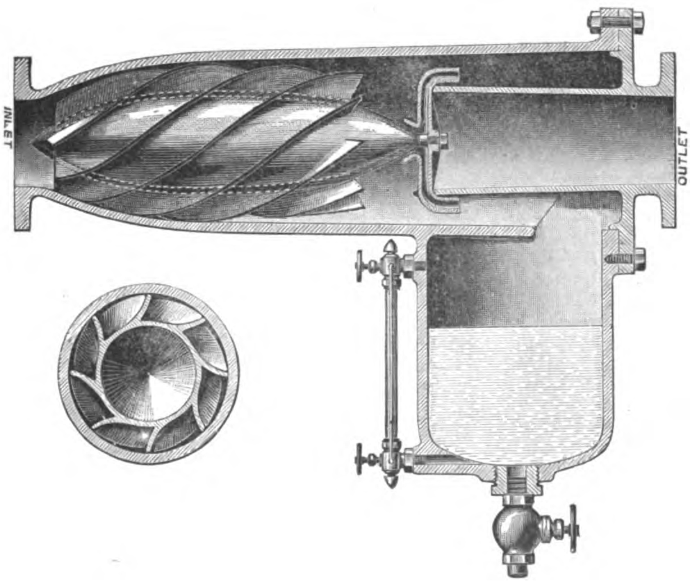
In the interest of economy, it becomes a necessity that all engines should be supplied with steam from which all entrained water and grease has been extracted. This result can be accomplished, it has been demonstrated, by the use of a thoroughly reliable separator, connected between boiler and engine, or between engine and condenser. Of those to which we may justly call attention as coming under this head is the device shown in the accompanying engraving, representing the De Rycke "Straight Line" Centrifugal Separator and Grease Extractor, which is manufactured by Joseph De Rycke, of No. 145 Broadway, N. Y.

The separator and extractor, which is shown in the accompanying engraving, consists of a shell or casing in which there is firmly secured a stationary double-ended cone. On this cone there are cast a number of knife-edged wings, extending spirally along its exterior, the annular space between the cone and shell of the separator being equal at its smallest cross-section to that of the steam pipe, from whence it is greatly enlarged. At the outlet end of the shell there is also an annular space, formed by an inverted outlet pipe. On entering the separator the steam is spread and thrown outward by the cone and given a centrifugal motion by the spiral wings. These wings are constructed with curved surfaces tangential to the cone, which is an important factor in the construction of the separator, as it materially aids in producing an outward impulse to the water or grease.

The steam on entering the separator is immediately expanded from a compact volume (due to the size of the pipe) into an annular space of equal volume, whereby its particles are removed farther from the centre, and thereby can receive a greater amount of centrifugal force. Under these favorable conditions the entrained water, grease, etc., meets curved angular wings along which it flows outward to the shell of the separator, and is collected in a well of ample proportions. Here it is entirely isolated from the flow of the dry steam, which passes off through the inverted pipe.

By subdividing the steam into a number of separate channels, every particle of the entire volume is sure to be acted upon, and the entrained water by being whirled along the shell and lodged in a separate chamber or receptacle is positively isolated from the flow of the dry steam, thus avoiding all possibility of its being picked up again or producing condensation by contact.

The Edison illuminating and power companies of New York, Pennsylvania, Ohio, Indiana, California, Texas, Rhode Island and Wisconsin are using these separators and extractors. They are also being placed in all new installations of the General Electric Company. Some of the electric light plants have from six to twenty-two of the De Rycke separators in use, varying in size from four to eighteen inches diameter of pipe. We notice that this device is also extensively used in electric street railway plants, on steamboats, and in mining and manufacturing plants.



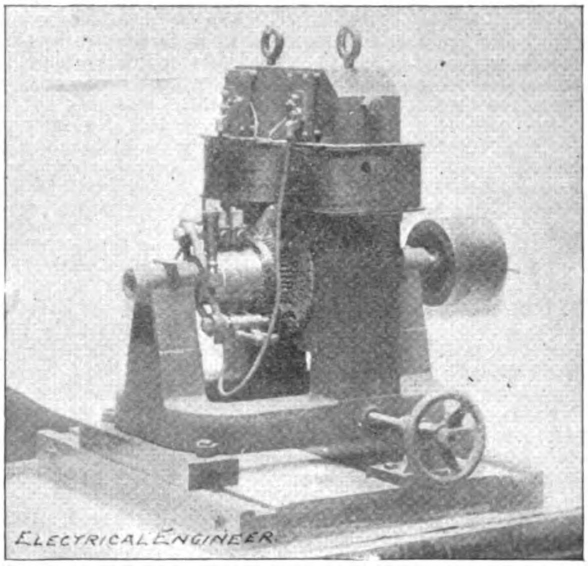
The De Rycke Centrifugal Separator.

Mr. De Rycke also manufactures a vertical "Straight Line" separator, which differs but slightly from the horizontal device, which we have described.

THE "COMMERCIAL" DYNAMOS AND MOTORS.

Constant potential motors and dynamos of moderate capacities may now be fairly said to have become a staple article of manufacture. In every large town and city hundreds and thousands of these machines may be found, doing the numerous classes of work for which they are adapted, silently, regularly and efficiently.

The line of machines from ¼ to 50 h. p., manufactured by the Commercial Electric Company, of Indianapolis, Indiana, under the patents of Mr. A. D. Adams, are designed to meet, in a high degree, the exacting requirements of this extended use. The aim in the design of these machines has been to produce only the best, and it is believed that this determination, coupled with several novel methods of construction, has resulted in a line of dynamos and motors, having all the desirable features, viewed from the user's standpoint.



The Commercial Dynamo and Motor.

The following are some of the characteristic features of these machines: All field magnet frames are made of forged wrought iron throughout, no cast iron being used in them. As a result of this construction a lighter, more sightly and more efficient machine is obtained. No other company in the United States, it is claimed, is using forged wrought iron, exclusively, for field magnet frames.

Gramme armatures of large diameter are used in machines from ¼ to 10 h. p., giving ample room for the many turns of wire required on these small machines for high pressure and insuring non-liability to burn-outs and affording ease of repair. Armatures in machines from 1 to 10 h. p. capacity are wound with but one layer of wire for the 110 volt pressure and but two layers for the 220 and 500 volt pressure, another feature which renders burn-outs unlikely and repairs easy. The point of commutation in these machines is constant under all changes of load within the capacity of the machines, due to the great strength of the field magnet and few turns of wire on the armature.

All starting boxes and rheostats are constructed entirely of incombustible material, with slate fronts. All terminal boards for mounting connections on motors and dynamos are of slate and all binding screws and binding posts of ample current carrying capacity and mechanical strength. All machines of 1 h. p. and over are provided with insulating sliding bases and belt tighteners.

The above points will, no doubt, be highly appreciated by those experienced in the setting up and operation of dynamos and motors.

MR. MACKAY'S CHRISTMAS TREE.

Mr. John W. Mackay has again sent over the Commercial cables his Christmas and New Year's greetings to the staff on the lines, accompanied by a "Christmas Box" in the shape of an order for the payment of an extra half month's salary.

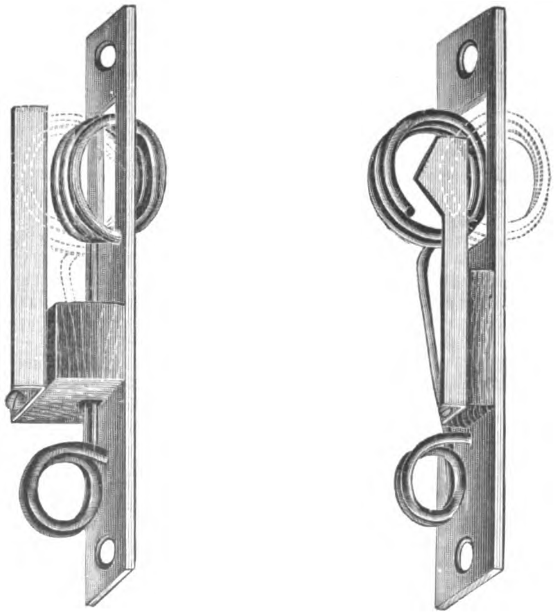
Mr. Mackay in his message complimented the men on their work during the year just closing and said he felt sure of the continuance of their co-operation in maintaining the leading position of the Commercial Cable Company. The "Commercial" staff are highly fortunate in being thus remembered.

THE FIRE IN THE BUFFALO, N. Y. STATION.

A BAD fire occurred on Friday, Dec. 16, at the Court street station of the Buffalo General Electric Company, followed up, in quick succession, by the break down of the big Corliss engine in the Wilkeson street station, by the snapping of the piston rod. Mr. C. R. Huntley, the general manager of the company, writes us on Dec. 19: "It is very unfortunate that the fire should have occurred just at this time of year, but we are not as badly crippled as we at first supposed. Our engines and boilers are in shape to run, and in fact on Friday night (the fire occured on Friday morning at 5 o'clock) we had four generators for arcs running in the station. The fire originated at the switchboard and ruined all the dynamos and electrical apparatus. We were able to get from Cleveland and from the General Electric Company, by express and special train, apparatus to duplicate everything we had; and if nothing goes wrong with us, by to-morrow night the public will not know we have had a fire. Through the various stations we have been able to couple things together, and the city has not been without light any night. Many of our customers on the incandescent circuits have been taken care of from some of the other plants. We shall use the same building, as it was not injured very much, being a well constructed one so far as fire is concerned."

THE "HARD" WINDOW AND DOOR SPRING.

THE protection of buildings from thieves and other trespassers has given rise to a variety of forms known as window springs, and among these are devices to give an alarm of the raising of a window. This spring must be so designed that a slight raising of the window gives the alarm, while on the other hand the closing of the electrical contact must be absolutely certain in order to insure the attention of the occupants of the house to the attempted invasion. A window spring embodying these qualities in an eminent degree, has been designed by J. Randolph Hard, of No. 2 Howard street, which is illustrated in the accompanying engraving. Fig. 1 shows the window spring which is let into the window frame at the side when the sash is raised. As will be seen, the spring consists of a piece of spring brass, the lower terminal of which is given two or three turns which lie close together, and directly opposite a brass knife edge which forms one side of the circuit, the spring forming the other. In the position shown, the spring is out of contact with the knife edge, and the circuit is open, the sash being cut out; as soon as the window is raised, however, the lower edge of th · sash strikes the spring protruding through and pushes it into contact with the knife edge, as shown in dotted outline, thus closing the circuit and ringing the alarm. There is evidently nothing to get out of order in this arrangement, and the contact is absolutely a certain one, as we have had occasion to learn by experience.

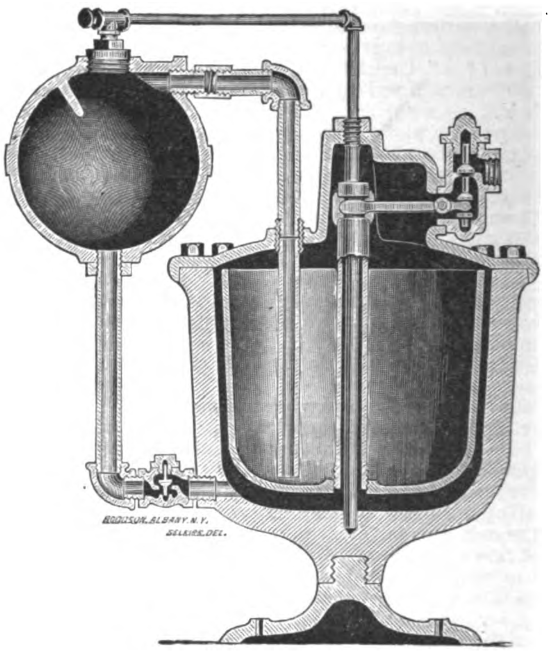


FIGS. 1 AND 2.—"HARD" WINDOW AND DOOR SPRING.

Fig. 2 shows the same principle applied to a door spring, except that the spring is at tension when the door is closed and is released to make contact when the door is ever so slightly opened.

THE "ALBANY" BUCKET RETURN STEAM TRAP.

THE accompanying illustration shows a sectional view of the special bucket return steam trap manufactured by the Albany Steam Trap Company, of Albany, N. Y., which automatically drains the water of condensation from all heating apparatus and returns it to the boiler, whether the coils are above or below the water level in boilers.



"ALBANY" BUCKET RETURN STEAM TRAP.

As will be seen, the equalizing steam valve and the devices for actuating it are wholly inclosed within the trap, thus obviating stuffing boxes and other contrivances. The mechanical arrangement consists of an outside case containing a movable bucket which travels upon a central guide-rod, and is provided with a tube surrounding this rod, the lower end of which is screwed in the bottom of the bucket, and the upper end provided with two lugs for receiving the end of the lever that operates the equalizing valve.

Connected with the trap is a spherical tank, provided with two connecting pipes, one communicating with the annular space exterior to the bucket, as shown with check valve near the lower left side, and the other connecting the upper part of tank with the interior of the bucket, as shown by pipe leading down to near its bottom. The equalizing steam valve is shown connected to the upper right side, and the lever for operating it, with its end inserted between the two lugs of the tube that is screwed in the bottom of the bucket. Both the receiving and discharge pipes are provided with check valves, the one in the receiving pipe opening to the interior of the trap, and thus preventing any water being forced back into the system when the equalizing valve is open, with boiler pressure in the trap. The check in the discharge pipe (not shown) opens to the interior of the boiler and prevents any water from the boiler being forced back into the trap when there is a lesser pressure in the trap than in the boiler.

J. BERLINER.

MR. J. BERLINER, of Hanover, whose "Universal" telephone transmitter is well-known and widely used, has recently established a branch office and factory in Vienna, Austria. The latter will be in charge of Mr. Max Hahn, who has been associated with Mr. Berliner for a number of years.

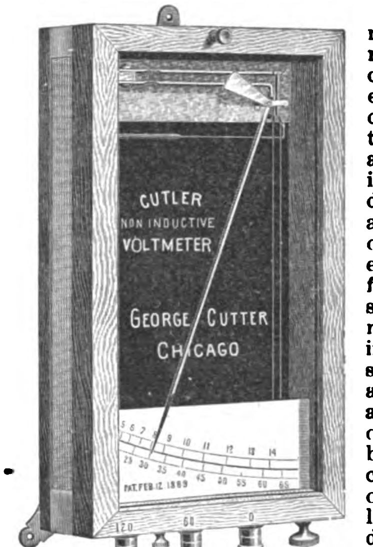
CITY STREET LIGHTING WITH WARD ARC LAMPS.

WE learn from Mr. Edwin S. Tice, manager of the Gladstone Electric Lighting and Power Company (Edision system) of Gladstone, Mich., that the city council has made a contract with the company for street lighting, the Ward arc lamp to be used in the business districts and 32 c. p. incandescents in the residence portions.

THE GLOBE ELECTRIC CORDAGE WORKS.

THE firm of Alfred F. Moore, Third and Race streets, Philadelphia, have purchased the entire plant of the Globe Electric Cordage Works, of 1002 Arch street, Philadelphia, and will carry on the business with the good-will of the latter company.

THE CUTLER NON-INDUCTIVE VOLTMETER.



Cutler Non-Inductive Voltmeter.

VOLTMETERS as well as ammeters when built with magnets, solenoids or magnetizing coils cannot be expected to work equally well under varying conditions, and are apt to be entirely misleading when used on alternating circuits. The reading of any magnetic instrument depends partly on the field around it. so that large masses of iron and steel as found in every dynamo-room will interfere with the correctness of such an instrument. With alternating currents, the coils in an instrument offer an extra resistance due to self-induction and this varies with the rate of alternations. Thus while the ordinary voltmeter may have been carefully calibrated for a current with a certain number of alternations per minute, a little change in the speed of the dynamo will render it inaccurate.

For these reasons there has been a demand for a voltmeter using no magnets, armatures or coils, and this is met by the "Cutler Non-Inductive Voltmeter" shown in the cut. This is built on the same general lines as the ammeter recently illustrated in our columns, the movements of the needle depending on the difference in expansion of two fine wires. One of these carries the current and does the measuring, while the other compensates for changes in temperature of the room. The binding posts are protected by rubber covers and are placed at the lower edge, while the resistance used in series with the expansion wire is put back of the instrument proper. The heating effect is the same for continuous, pulsating or alternating currents of a given pressure so that this voltmeter is equally well adapted for any system.

The Cutler instruments are perfectly dead-beat, as it is impossible for the needle to move further than the expansion of the wire will permit. In other voltmeters the momentum of the moving part will carry it beyond the proper mark, after which it will vibrate for some little time. This annoying feature is avoided in the Cutler non-inductive voltmeter, in which the needle swings to the proper mark and stops there without any hesitation. For this reason a series of readings can be taken in very quick succession. These voltmeters are made with either a single or double scale to meet the varying requirements. Some built for storage battery work allow the needle to swing clear across the scale with less than three volts pressure, while those for street railway work range as high as 850 volts. Quite a number have been in use during the past year and the maker, George Cutter, of Chicago, is well pleased with the results. These voltmeters are licensed under the Cardew hot-wire patents.

THE CHICAGO ELECTRIC WIRE COMPANY.

THE insulated wires and cables made by the Chicago Insulated Wire Company, of Wilmington, Del., are having a very severe test. Seven cables were laid in the mud at the bottom of the Cristiana and Brandywine Rivers three years ago last month for the Wilmington Electric Light Company, and have all been in contant use without a single case of trouble ever since; they carry a current of 2,000 volts from a Westinghouse machine. The cables are No. 5, A. W. G. insulated with Chicago Electric Compound incased in a lead pipe and armored. The Wilmington City Electric Railway Company also have at the same place two 0000 A. W. G. cables of the same construction, and the Wilmington Water Department have just ordered five miles. This company are the successors of the Cobb Vulcanite Wire Company, but have gone into the business on a far greater scale, making everything in the insulated wire line. It is the intention of the company to spare no expense in its efforts to make this not only the largest but the leading insulated wire company, and also in the near future to build a plant in Chicago to supply the large and increasing demand.

THE SHULTZ BELTING COMPANY.

THE 1892 catalogue of the Shultz Belting Company, of St. Louis, Mo., has gone into its fifth edition. It is a most useful little book to all power users and contains much condensed information on the selection and management of machine belting, together with tables for the determination of the width of belts, horse power, etc.

THE JONES BROTHERS ELECTRIC COMPANY.

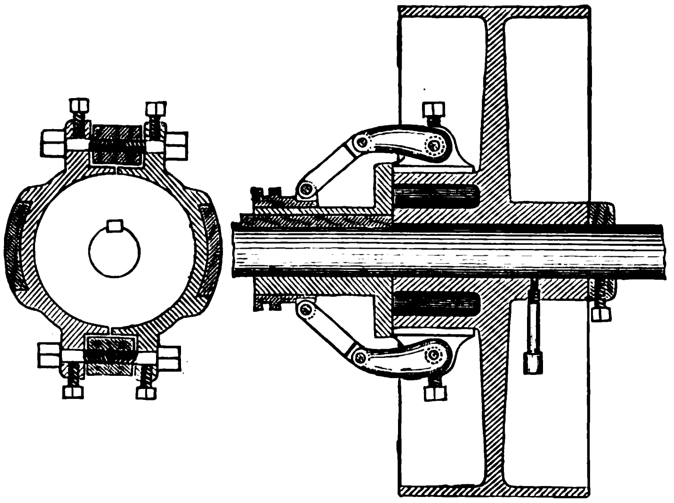
THE general electric supplies handled by the Jones Brothers Electric Company, of 28-32 West Court street, Cincinnati, Ohio, are well set forth in a catalogue of 345 pages issued by them, and containing descriptions and illustrations of apparatus covering the electrical field in a very thorough manner. The company are agents for the Perkins lamps and the Mather dynamos and motors.

BARNES FRICTION CLUTCH PULLEYS.

THE accompanying illustrations represent the principles of a friction clutch pulley and cut-off coupling manufactured by the J. H. & D. Lake Company, of Hornellsville, N. Y.

Fig. 1 affords a sectional side view of the Barnes screw lever friction pulley in released position, showing the driving hub keyed to the shaft.

Fig. 2 is a sectional end view showing the friction hub encircled by the friction ring, the former of which is cast in one solid piece with the pulleys. Projecting lugs on opposite sides of the driving hub of the ring drop into lug cavities of the friction ring; and when the clutch is on, these lugs take all the driving power. At the extreme top and bottom of Fig. 2 is shown a view of a simple device which evades the use of much complicated machinery and more than substitutes the corresponding complex parts of some previous inventions. It is a lever nut on each side of the friction ring, one-half of the nut being cut with a right thread and the other half with a left thread. Sufficient space between opposite sections of the ring is given for contraction or clutch, which is effected by means of right and left thread screw bolts entering the lever nut from opposite sides, secured by set screws. Duplex levers are attached to these nuts at their upper sections and to the hub at their lower sections. When the shipper sleeve is thrown against the flange by the operating lever, the duplex lever turns the nut sufficiently to produce a friction that is claimed to have never been known to lose its grip. The screw bolts are adjustable to any desired pressure, however, in case the clutch should ever become lax. They give the pulley a positive grip and absolute release from the hub by each opposite shift of the operating lever, without the use of springs. The Barnes screw lever friction clutch pulleys and cut-off couplings are adapted to both heavy and light work.



BARNES FRICTION CLUTCH PULLEY.

BALTIMORE NOTES.

THE GENERAL ELECTRIC COMPANY have just started up the blower plant in the Baltimore and Potomac Tunnel. Vast volumes of smoke are ejected from the high stack at the corner of Wilson and Madison avenues.

THE BRUSH ELECTRIC LIGHT COMPANY is just installing a 250 h. p. coil boiler, as the old boiler plant has been taxed to the utmost by the increased load this Fall.

H. K. MCCAY, electrical engineer and contractor, has just installed 200 lights for the William Knabe Piano Factory in South Baltimore.

THE BALTIMORE TRACTION COMPANY are all ready to begin operation on the Cary Street Electric Line, but are compelled to wait on a curve, which has been delayed by labor troubles in Pennsylvania.

LAUREL, MD., will be lighted by seventy incandescent lights, Work will begin at once.

WESTERN NOTES.

The Railway Equipment Company, Chicago, report a very large business in the Ahearn electric heaters. Orders for car heaters have been received from Amsterdam, N. Y.; Peoria, Ill.; Williamsport, Pa.; Kokomo, Ind.; Great Falls, Mont.; Camden, N. J.; Jackson, Mich.; Albany, N. Y.; Lynn, Mass.: Burlington, Iowa; Fitchburg, Mass.; Cairo, Ill.; Des Moines, Iowa; Allentown, Pa.; Rockford, Ill ; Cleveland, O.; Detroit, Mich.; Brooklyn, N. Y.; Spokane Falls, Wash.; Alexandria Va.; Kansas City, Mo ; Quincy, Mass.; Salt Lake City, Utah; Chicago; Natick, Mass.; Terre Haute, Ind.; Marquette, Mich.; Elwood, Pa.; Escanaba, Mich.; Kankakee, Ill.; New Haven, Conn ; Galesburg, Ill.; Hammond, Ind.; and large orders have also been received for the Ahearn electric stoves and other devices.

Mr. A. H. Atwood, who was formerly a large manufacturer in the east, has started a most complete plant here for the manufacture of carriage lamps, electric specialties and electric arc lamps for all systems of lighting. He is located at 166-174 South Clinton street, and has equipped his shop with all the latest and improved machinery for the economical production of goods, and will undoubtedly do a large business. Mr. Atwood has had a long and extensive experience in this class of business and is amply qualified to build up a very large trade throughout the west. He intends to use only the best material in everything put out, and the workmanship will also be first-class.

The Electric Appliance Company, of Chicago, are placing on the market an improved ceiling rosette in the line of an improvement on the Shaefer cut-out with a removable cap. The cap is attached without screws by a quarter turn to the right and detached by a similar turn in the opposite direction. To prevent the possibility of the cap jarring loose, which has been the great difficulty in other cut-outs of this style, a supplementary phosphor bronze spring has been added, making loosening almost an impossibility. The cut-out is placed on the market under the name of the "Acme Ceiling Cut-Out."

The merits of the Burton Electric Car Heaters were fully exemplified during the recent cold snap in the West. The heaters rendered cars in which they were used comfortably warm, without taking an excessive quantity of current. Mr. W. R. Daum, president of the Ottumwa Electric Road, speaking on this subject, said : "The fact that we commenced using the heaters three seasons ago and have continued to use them, buying four more sets for four new cars put on this fall, is best evidence possible of the work they have done and are doing for us."

The Pioneer Armature Works, room 415, 195 to 199 South Canal street, Chicago, are making a specialty of rewinding fields and armatures, renovating commutators and making other repairs on electrical machinery. They make an exclusive business of this line, and are prepared to guarantee good work at the best prices. They also make a special point of getting their work done with the utmost despatch. Immediately an armature or other piece of machinery is received it is repaired, and in this way they have acquired quite a reputation.

The Enterprise Electric Company, of 313 & 315 Dearborn street, Chicago, report a large increase in the sale of National India Rubber covered wire. Other electrical supplies are in great demand, and the company has been rushed since moving into its new quarters. It is about to put on the market a new flush switch, for which it has the exclusive agency. The St. Louis branch, W. H. Ferris, manager, reports a good and growing trade.

The Diamond Transformer.—Taylor, Goodhue & Ames, 827 Monadnock Building, Chicago, have closed a contract with the manufacturers for the entire output of the factory, and are preparing to properly introduce the transformer to central station managers. The "Diamond" possesses merit which will insure for it a high place in the opinion of practical men—it is said to be a record breaker.

The Charles F. Elmes Engineering Works will move during next January to their new works, corner of Morgan and Fulton streets, where they will install a large amount of new and improved machinery and have facilities for handling larger work than heretofore. Among other tools which they will install are a 20-ton traveling crane and a 10-inch boring and turning mill.

Mr. J. F. Kester, who is well known in electrical circles in the west, resigned from the Kester Arc Lamp and Manufacturing Company, of Ironwood, Mich., a short time ago, and associated himself with Mr. A. H. Atwood. They will design and bring out several important pieces of electrical apparatus.

Mr. W. J. Browne, secretary of the United States Electric Light and Power Company, of Dubuque, Iowa, was a Chicago visitor last week, looking after the purchase of additional machinery for his plant.

The Rice Machinery Company have a large number of contracts under way. Their business is very steady with electrical people and continually increasing.

Mr. Fred De Land's new paper, *World's Fair Electrical Engineering*, offers $175 in prizes for the best short essays on "How Can the Department of Electricity at the World's Fair Best Help the Electrical Interests?" The contest is open to all, and the essays must be in by January 14.

The Central Electric Company have just taken the agency for a combination tin shade, both flat and cone shaped. These shades are made under the patent granted to F. H. Soden, and will be known as the "Central Combination Shades." The trade can have their wants supplied by applying to the Central Electric Company, who will carry them in stock hereafter.

Mr. F. B. H. Pain, who was formerly connected with both the General Electric and Westinghouse companies, has joined the force of the Siemens-Halske Electric Company as assistant Mr. Amiel Meysenburg, of O. N. Meysenburg & Co., the St. Louis agents of the company.

Mr. W. W. Splane, superintendent of telegraph of the National Transit Company, with headquarters at Oil City, Pa., is spending a few days in Chicago. Mr. Splane is also filling the capacity of electrician to the Standard Oil Company.

The Columbia Manufacturing and Supply Company, Mr. John T. Todd manager, are bringing out a number of novel electrical devices, among others an electric cigar lighter and a new dry battery called the "Jupiter."

The Great Western Electric Supply Company are keeping up the volume of their business, and trade is very brisk with them, both in general electric supplies and the various specialties they manufacture and handle.

Mr. S. Dana Greene, assistant general manager of the General Electric Company, spent some days in Chicago recently.

The Siemens-Halske Electric Company are making rapid progress in the completion of their large factory.

Mr. Charles D. Shain, of New York, was among the visitors to the World's Fair City last week.

NEW YORK NOTES.

W. R. Fleming & Co.—The rapidly increasing business of this firm in Central and New England States, has made it necessary for them to open a branch office in Boston to look after that trade. They have obtained offices in the Hathaway Building, 620 Atlantic avenue, and have secured the services of Mr. Walter W. Jones, as manager. Mr. Jones is a man of long experience in the highest grades of steam engineering work, and is well known throughout the New England States. He has already secured several contracts and has other large work in hand. Since the reorganization and re-equipment of the Harrisburg Foundry and Machine Works, the class of work turned out as shown in both simple and compound Ide and Ideal engines compares with the best engineering work of similar lines. There has been almost constant work day and night to keep up with increasing orders and contracts, and further extension of plant is contemplated to take care of present and prepare for future work.

Mr. Willard W. Low, president of the Electric Appliance Company, Chicago, was a visitor in New York the past week. He spent several days in the city in search of novelties, in the way of electrical supplies generally. Mr. Low visited while in the East all the large cities, calling on most of the important manufacturers. Some desirable connections have been made, and there is reason to believe that the Electric Appliance Company will "be heard from" after the first of the year.

Lieb Machine Works.—All communications regarding, and orders for, railway line material manufactured by the Lieb Machine Works, should now be addressed to the General Electric Company; full arrangements having been made to this effect.

Mr. F. S. Terry, of the Electrical Supply Company, Chicago, has been a visitor to the East during the past week or two, and while in New York favored the office of **The Electrical Engineer** with a call.

The Caldwell Boiler Company, 15 Cortland street, N. Y., has been awarded the contract for supplying 600 h. p. of boilers in the Metropolitan Realty Company's new fourteen story building.

The Berlin Iron Bridge Company, of East Berlin, Conn., have the contract for three new iron buildings and iron roofs for the East River Gas Company, to be built at Ravenswood, L. I.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

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